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Implementation of Illumination Control System Using Sensor Integration

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Abstract: Most of the lighting uses expensive electric energy. In simple lighting, maintenance of pleasant environment and applications as various information transmitting means are increasing and usage is greatly increased. Recent trends in lighting equipment control technology can be classified into new light source technology, energy saving function, environment friendly, human friendly emotional lighting and fusion. In this study, we used TCP/IP communication method for the lighting control controller and the central control computer in the existing management method that, we directly observed and managed the lighting devices distributed in each region. Through this, we propose a system that can check the status of the lighting equipment in real time and control the lighting directly or indirectly. The proposed research is capable of energy saving and effective lighting management. Also, the time schedule program automatically turns on/off the lamp for effective lighting management and energy saving. It can also be applied to fire and security systems by adding various sensors to the controller input part.

Key words: Microcontroller, Winsock control, RS-232C converter, relay driving circuit, devices, expensive

INTRODUCTION

In order to improve economic growth and the welfare sector, it is essential to secure and supply energy that is the driving force of industry and people's lives. However, in Korea where domestic endowed resources are lacking, there is an energy vulnerability of the energy condition that needs to rely on imports for all the increasing energy demand. In order to overcome these problems, energy conservation and efficient energy use that can be pursued without being affected by international energy supply and demand trends are becoming important tasks. Especially, as the buildings are getting bigger and bigger, the energy demand of the building sector is on the rise (Kim *et al*., 2011). In the case of office building, it is necessary to efficiently manage electric power which occupies about 40%. The introduction of design and control methods is required.

The lighting control technology used in existing lighting control systems uses a simple control method that can adjust the sensitivity of the sensor, adjust the illuminance, manage the schedule by time frame and designate the point. And the lighting control system is equipped with the lighting control management software that manages the entire operating system (Shin and Kim, 2013). A lighting control module for controlling hardware components and a database module for managing and analyzing various data. Various data stored in each local controller can be stored in the database and it can be operated according to the analysis and the situation in the field. It is possible to adjust the sensitivity and illumination of the sensor, manage schedule by time frame (Lakshmanan *et al*., 2013). However, most of the lighting control systems are structured in such a way that they cannot be operated or set up for lighting control. Even if the PC fails or shut down, each local controller sends and records the corresponding system data, so that, no system failure occurs. All system management is ID granting method and it enables remote control for each sensor (Gonzalez *et al*., 2004). Therefore, it is urgent to develop related technologies because it is possible to save energy up to 90% through the application of the management system through the lighting control.

In this study, we used TCP/IP communication method for the lighting control controller and the central control computer in the existing management method that we directly observed and managed the lighting devices distributed in each region. Through this, we propose a system that can check the status of the lighting equipment in real time and control the lighting directly or indirectly. The proposed research is capable of energy saving and effective lighting management. Also, the time schedule program automatically turns on/off the lamp for effective lighting management and energy saving. It can also be applied to fire and security systems by adding various sensors to the controller input part.

STATUS OF ILLUMINATION CONTROL SYSTEM

Recently, the node control of lighting system has attracted attention such as the standby power cutoff device due to energy saving, the electronic safety cutoff device for safe use of electric power and the electronic

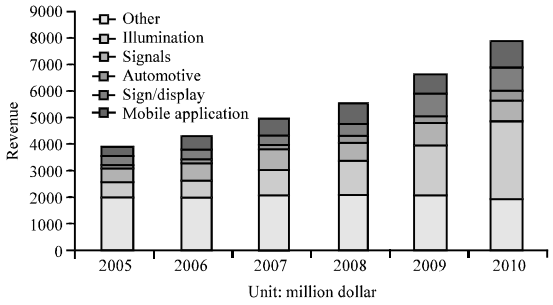

Fig. 1: LED Illumination market scale

watt hour meter and the light control device for the remote meter reading in the home network field (Ahmed and Shoyama, 2011). There are three main ways to control the voltage of the lighting system: using a transformer, using intermittent pulses and using phase control. Since, the magnetic ballasts which have been used up to now are operated in a low frequency band and have various disadvantages such as low efficiency, audible noise and flicker, they are being actively developed and replaced with electronic ballasts worldwide in Fig. 1 (Shahat, 2010).

Most domestic and international technologies are mainly concerned with the development of a hybrid streetlight remote control system equipped with multiple sensor processing functions. First of all, related technologies are important for streetlight control system and key technologies such as power control technology, communication control technology and multi-sensor integrated board technology. Power control technology for remote control which is the core technology of streetlight control system is currently being developed. It includes standby power cutoff device for energy saving, electronic safety cutoff device for safe use of electric power, electronic watt hour meter and lighting control device for remote meter reading in home network field This is attracting attention. There are three main ways to control the voltage of the lighting system using a transformer intermittent pulse and phase control. Since, the magnetic ballasts which have been used up to now are operated in a low frequency band and have various disadvantages such as low efficiency, audible noise and flicker, they are being actively developed and replaced with electronic ballasts around the world. The use of electronic ballasts can save 25% of the power consumed and the light output and lifetime of the lamp can be increased (Jia *et al*., 2014). Therefore, it is possible to control the electronic ballast this is urgent.

Communication control technology has been attracting attention in the home network or home automation field for connection and utilization of various electric/electronic devices and communication devices in the home or office, due to the widespread use of the internet and the development of communication technologies. Integrated standardization of communication technology has not yet been standardized and development is underway to perform comprehensive control to support various protocols and to support remote control using wired/wireless communication line or internet network. The multi-sensor integrated board technology developed the environment, facility information acquisition and USN-based sensor technology according to u-City activation (Albreshne *et al*., 2014). Currently, the data acquisition method using the sensor uses a method of installing sensors in various places. Since, the technologies that can integrate, control and communicate sensors are at the level of the idea stage, the USN has various wireless access technologies according to the application characteristics and it is difficult to standardize it, so, it is necessary to secure the multi-platform based wireless access technology in Fig. 2 (Bae, 2014).

In this study, we have developed a technology to process multiple sensor data in order to improve the simple control method which can only make the entire lighting control technology. TCP/IP communication method that can support various protocols and support efficient remote control is used for technology development (Seremeti *et al*., 2009). The data acquisition using sensors based on 8 bit microcontrollers can be achieved by securing multi-platform wireless access technology for technology development and by adjusting the sensitivity of multiple sensors, it is possible to manage schedule by time zone, the data stored in the gateway are stored and analyzed in the database, so as to be able to be used as a material and the structure is improved, so that, operation and setting for situational lighting control can be performed through the result value (Jeong *et al*., 2007).

DESIGN AND DEVELOPMENT OF SYSTEM

Recently, a lighting control system with reliability and economy has been developed and popularized. As a result, a lighting control system that is highly functional and greatly improved in convenience of use has been actively studied in order to save energy without incurring inconvenience to meet various demands of the highly information-oriented era and to avoid simple energy saving methods.

Therefore in this study, we designed and developed a lighting control circuit through system analysis and design techniques. In addition, we have developed a system that can remotely control via. RS-232C converter.

To do this, we designed the lighting control circuit using an 8 bit microcontroller and realized remote control by implementing Ethernet communication. Figure 3 shows the overall system configuration.

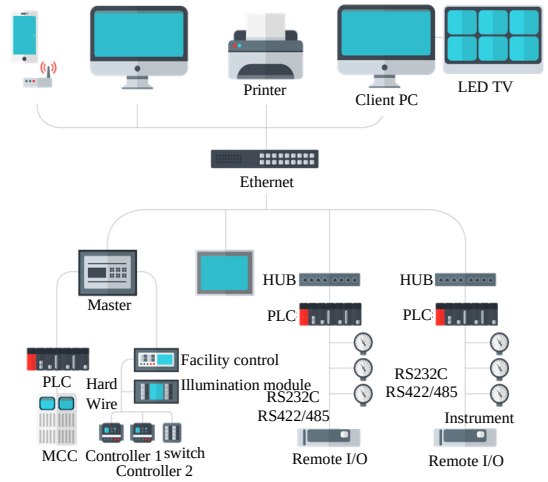

Fig. 2: Illumination management system

Various sensors such as illuminance sensor and human body detection sensor were configured at the main controller input part. The circuit is configured and designed to operate the controller by sensing events related to lighting control such as external light brightness and human motion. The pin numbers, functions and specifications of the 8 bit main microcontroller are as shown in Table 1. The block diagram of the illumination control circuit designed in this study is shown in Fig. 4.

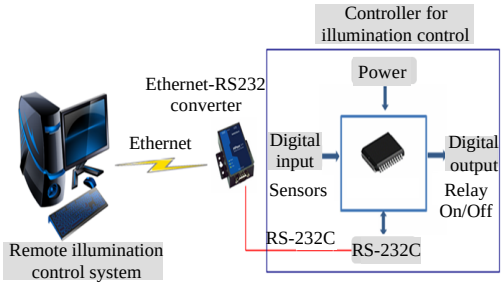

Fig. 3: System configuration

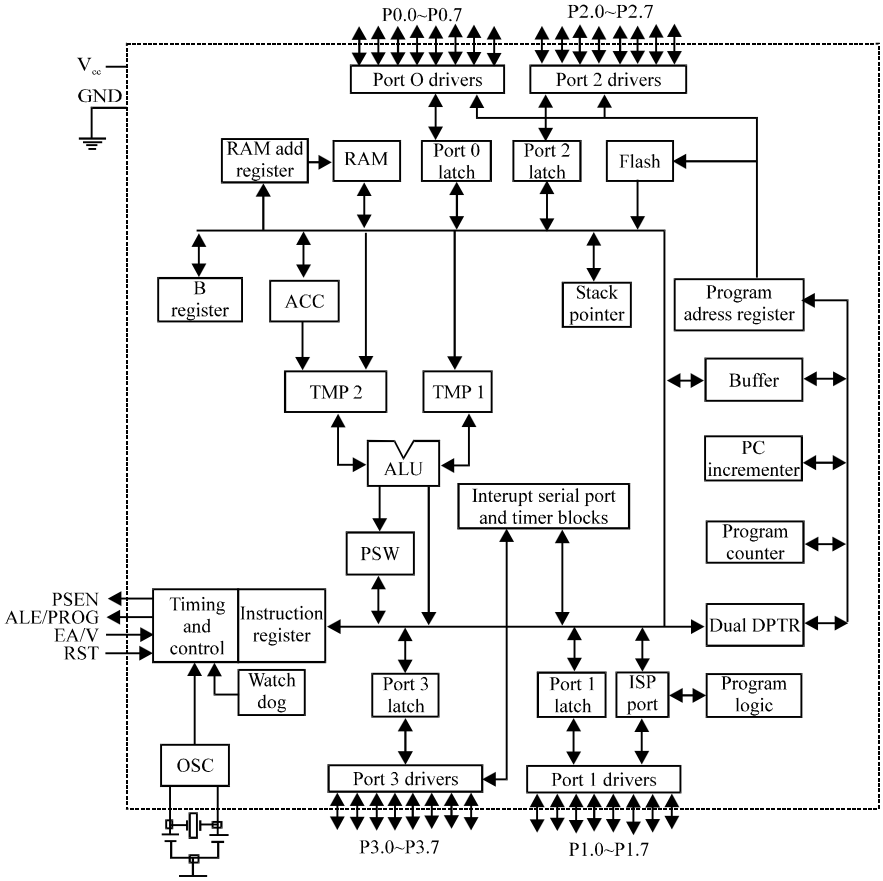

Fig. 4: Block diagram

The 8051 has five interrupt sources, two interrupts, two timer interrupts and one serial port interrupt. The IE (Interrupt Enable Register) used to mask these interrupts and the IP (Interrupt Priority Register). Also, the MAX232 consists of a power supply circuit that converts the 5 V voltage to 10 V using an internal charge pump and then inverts it to-10 V and a circuit composed of an inverter as described above. In the case of a capacitor, C1-C4 are absolutely necessary and C5 is used regardless of whether or not the capacitor is used. The MAX232 circuit diagram is shown in Fig. 5 and 6.

Table 1: Microcontroller pin functions

P. No.	Pin name	Function
P3.0	RxD	In serial communication, the receiving terminal (Input)
P3.1	TxD	In serial communication, the sending terminal (Output)
P3.2	INT0	External interrupt 0
P3.3	INT1	External interrupt 1
P3.4	T0	External timer interrupt 0 (Input)
P3.5	T1	External timer interrupt 1 (Output)
P3.6	WR	External data memory output strobe
P3.7	RD	External data memory input strobe

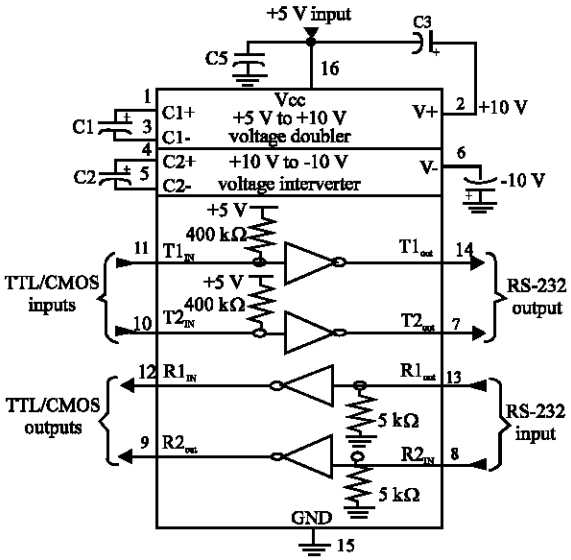

Fig. 5: MAX232 circuit diagram

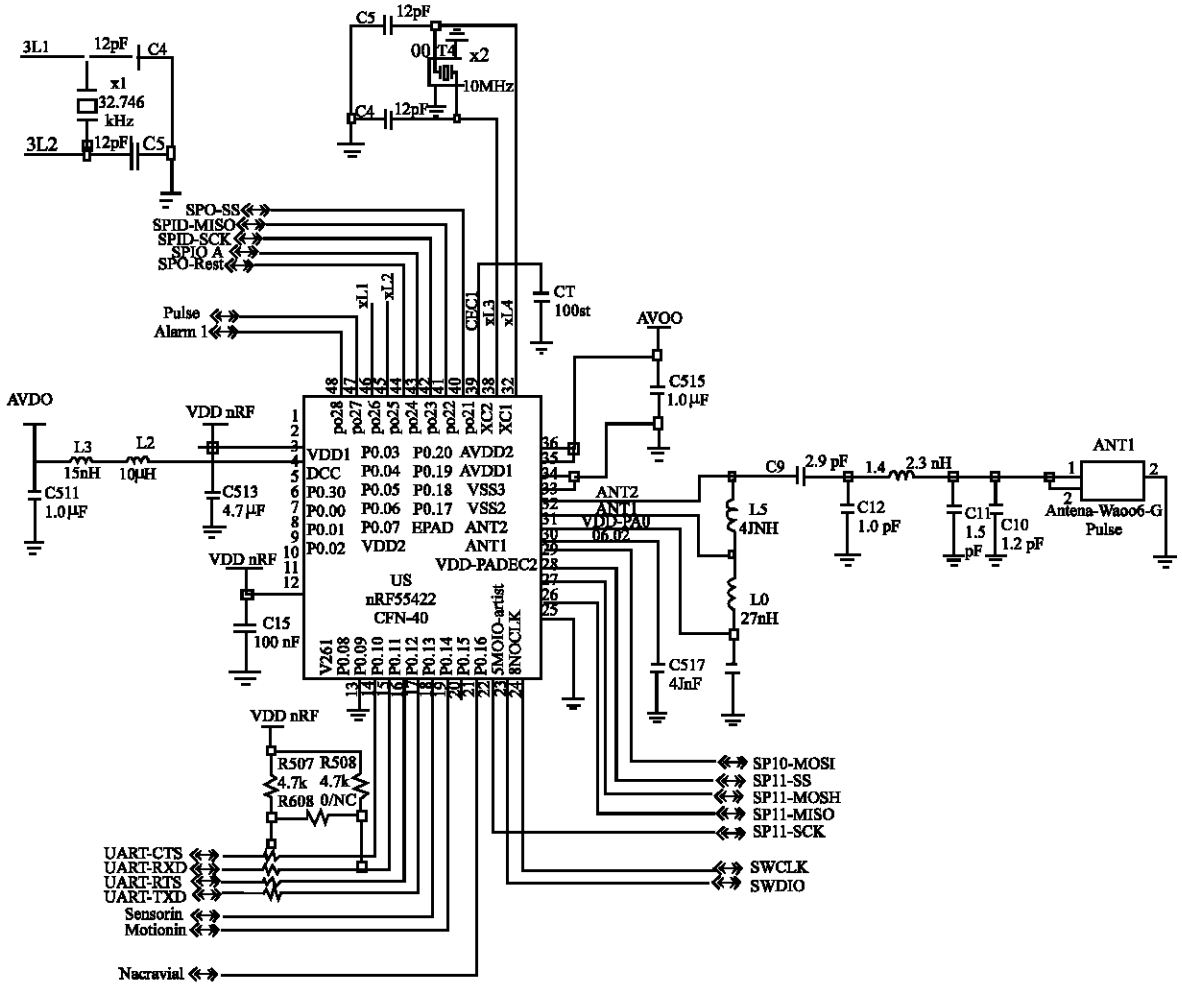

Fig. 6: Remote illumination control system circuit

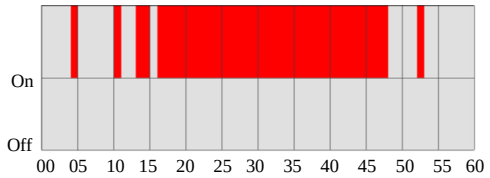

Fig. 7: Illumination status graph

Inside the MAX232, the inverter is turned on and the signal is inverted. Originally, the RS232 specification is that -12 V is "1", +12 V is "0" and it is inverted through the inverter, so that, +5 V becomes "1" and 0 V becomes "0".

Control operation through controller is classified into function parts. In the A/M controller, control is performed by sensor and remote control system through auto function and on/off control is performed by manual function. In the L/R controller, control is performed by the sensor through local function. And in the remote function, on/off control is performed by the local SW. Finally, the circuit diagram of the remote lighting control system designed in this study is shown in Fig. 6. Also, Fig. 7 shows the state of lighting status by time of day.

CONCLUSION

In recent years, new and efficient technologies continue to be developed and information communication technologies which are already making great progress are being actively used in lighting control systems. In the case of large buildings, the existing building management system controls lighting loads in terms of building management. However, even in this case, the actual lighting control was not actively controlled. Now, lighting control becomes easier and more intelligent control becomes possible which is being applied in various subdivisions such as small offices, parking lots and street lamps. Lighting control basically requires a light source and a ballast and a controller to drive or light the light source.

The remote lighting control system designed and developed in this study is convenient to operate by monitoring the operation status of the devices scattered in each region at present from one place and it has a reduction effect of the management personnel, a total operating time an alarm time and details can be checked in real time from the central computer, so, it is possible to cope with an immediate situation in case of an alarm. Also, the time schedule program automatically turns on/off the lamp for effective lighting management and energy saving. It can also be applied to fire and security systems by adding various sensors to the controller input part.

In this study, we introduce the more advanced and new ones in the existing lighting control system and give examples of practical construction and application. Now the lighting control system is at a stage where it can be easily configured or applied by the user with LED lighting. Therefore, it is expected that there will be many applications in large and small application environments in the future.

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