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A Study on the Safety Control System of Child Care Systems Using Interior Lighting and Entry Systems

Dae-Chul Joo[1], Mee-Rhan Kwon[2], Seung-Jung Shin[1*]

[1]*Dept. of IT convergence, Hansei University*
[2]*Dept. of Child Studies, Korea Nazarene University*
john@kicic.or.kr, mrkwon@kornu.ac.kr, [*]expersin@gmail.com

Abstract

Despite the government`s various safety measures, the number of safety accidents continues to rise and the interior is more likely to occur indoors than outdoors. Safety accidents involving young children account for more than 70 % of the safety accidents in the safety accidents, and the ratio of safety accidents in the classroom or classroom is more than 50 %. In this thesis the author proposes the system managing the accidents notification service using LED lighting and access entry control. Utilizing IoT technology, remote control or access can be controlled remotely by controlling multiple lights and entrances from each room and by means of a number of lighting and entrances. By monitoring and analyzing real-time status via server PC and mobile interface, it can control the maximum control and incident prevention, automatic control, and automatic control.

Keywords: *IoT, Arduino, CDS, LED, Child Care Systems, Safety Control System*

1. Introduction

There is IOT technology that can control all electronic devices in the house with smartphone. IOT technology is used to prevent safety accidents occurring in the nursery or nursery classroom. We want to manage entrance and exit more effectively through door control. Most of the existing access methods are button-type panels, and if the password is leaked, it will not allow the security of the outsider. If the password is not leaked, it will be difficult for outsiders to access it, but it is often difficult to forget the password. It also manages the lighting to save energy more effectively. In this paper, the user recognizes the face of the visitor through access control, approves access / denial, and helps to save energy and safety through lighting management. As shown in Table 1, the number of safety accidents in nursing homes is increasing stea

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Corresponding Author: expersin@gmail.com
Tel: +82-31-450-5274, Fax: +82-31-450-5172
Dept. of IT convergence, Hansei University

Table 1. Kindergarten safety accidents in 2012-2014 (Unit:%)

Division	inside								Outdoor					Total
	nursery	Baby room	Corridor / stairs	restroom	entrance	Restaurant	Cooking / Diocese Room	inside Etc	Outdoor playground	Place to visit	way	inside Etc	total	
2014	1009	1973	742	501	210	66	45	396	2119	807	568	722	4216	18238
2013	9068	1952	714	483	173	108	55	206	1691	746	478	589	3504	16236
2012	7231	1496	589	367	136	79	41	129	1338	623	360	463	2784	12852

Source: Nursing Home Safety Mutual Aid Association (2014).
Nursing Home Safety Mutual Fund Statistical Data Book .2012-2014 Data reconstruction

2. Related Works

2.1 Communication for access control system

In order to control the door, communication between Arduino and mobile (Android) must be made possible, and one of communication methods is controlled by using Bluetooth. In order to use Bluetooth to connect Arduino and Android, you need to grant Mainfests' Bluetooth privilege on mobile (Android).

```
<uses-permission
android:name="android.permission.BLUETOOTH" />
<uses-permission
android:name="android.permission.BLUETOOTH_ADMIN" />
```

Figure 1. Arduino Bluetooth authorization

As shown in Figure 1 above, you need to grant permission for Bluetooth to work. First of all, you have to solve the Bluetooth of Android and grant Bluetooth privileges in Arduino. In Arduino, you need to import a header file with Bluetooth control authority, and its header file is SoftwareSerial. This header file contains the RX || Use TX to result in D2 as RX and D3 as TX.

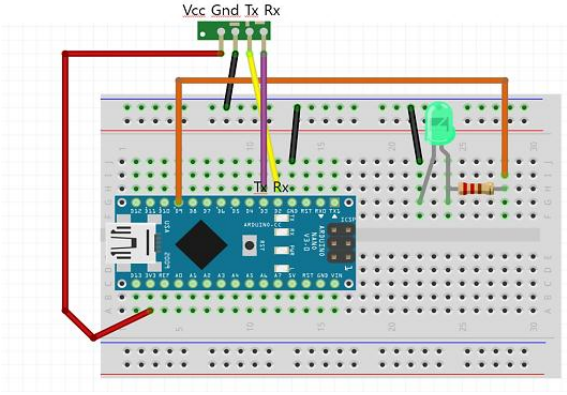

Figure 2. Arduino Bluetooth authorization

2.2 Lighting Control

An illumination sensor is needed to control the lighting. The illuminance sensor automatically brightens the light by the surrounding light source and darkens or turns off. For this purpose, a CDS illuminance sensor is required, and a CDS illuminance sensor is also called a light sensing sensor. When the ambient light is bright, the resistance decreases, and when the ambient light is dark, the resistance becomes large (see Figure 3).

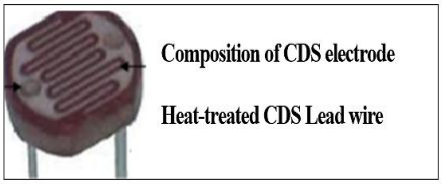

Figure 3. CDS ambient light sensor

The following is an implementation of the illuminance sensor using Arduino.

EntrySystem.ino (Arduino Sketch)

```
#define POT_PIN A0
#define LED_PIN 13

void setup()
{
   pinMode(LED_PIN, OUTPUT);
}
void loop()
{
   int val = 0;
   val = analogRead(POT_PIN);

   // If the illuminance sensor value is less than 100, turn on the LED
   if(val < 100) {
      digitalWrite(LED_PIN, HIGH);
   } else {
      digitalWrite(LED_PIN, LOW);
   }
   delay(500);
}
```

2.3 Access system control

At Arduino, the CIE-H12 sensor is used to determine whether the door is open or closed (see Figure 4). The marking sensor to be used with the CIE-H12 sensor is Samsung Techwin SIM-0001. The sensor uses 12V DC and the detection distance is 30mm. By using this sensor, it is possible to know whether the door is opened or closed. It also allows control of visitor access.

Figure 4. Door Control (SIM-0001 Sensor)

3. Change and application of control

Recently, the Internet of Things (IOT), which exchanges information with the network through the electric power field of Smart Grid, is getting attention. Therefore, IOT technology is used to prevent safety accidents in day care centers or classrooms. First, the mobile can check and control the access of the visitor so that they can approve / deny. Figure 5 shows the model for determining visitor access.

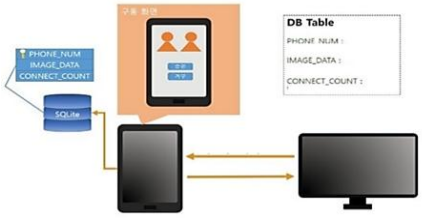

Figure 5. Door control (acceptance and rejection of the passengers)

The server receives the visitor's data and sends it to the access manager to help him / her judge. The LED illumination is automatically controlled by using the illumination sensor. Therefore, it saves energy more effectively and creates safe childcare and classroom environment through access control.

4. Suggestions for Integration Control

4.1 Implementation of Hardware System Design

Arduino, mobile, and light sensor for lighting control, and SIM-0001 for access control is suggested. The lighting controller is configured to receive data wirelessly received by the local controller on the mobile in consideration of the ambient brightness detected by the illuminance sensor.

The lighting control unit automatically darkens when the amount of brightness recognized by the illuminance sensor is large. The controller of the door allows the user to know whether the door is opened or closed by using the SIM-0001 sensor, and the data of the passenger is transmitted to the mobile so as to be approved or rejected.

EntrySystem.ino (Arduino Sketch)

```
void setup()
{
   Serial.begin(9600);
   lcd.begin(16,2);
   lcd.print("Close Door");
   pinMode(Door,OUTPUT);
   digitalWrite(Door,1);
}

   Serial.println("Connected to wifi");
   printWifiStatus();
   Serial.println("\nStarting connection to server...");

   if (client.connect(server, 8554))
   {
      Serial.println("connected to server");
      client.print("[Arduino1]");
   }
   char c = client.read();
   Serial.write(c);
   InitialTime();
   InitialHeartTime();
}
```

This is the setup () part of the Arduino. There is an lcd.begin (16, 2) function that displays the LCD settings for LCD display and sets 16 lines on 2 of 16 * 2 lines. Start Door with OUTPUT when pinion (Door, OUTPUT) starts for the first time.

The illuminance sensor can be configured to recognize the ambient light source. This is to control the LED dimming according to the ambient light source difference. And, when the light source peak value is exceeded, it is used to deal with a failure or an error through measures to cut off power in real time. Human body detection sensor uses a heat sensor as main sensor and one or more of infrared ray and ultrasonic sensor is used as an auxiliary sensor. When human body movements are recognized in the environment where LED lamp is installed (See Figure 6).

The local controller recognizes the movement of a person in a predetermined space according to a sensor signal received from one of the sensor devices, such as sound, illuminance, and human body sensor, generates an illumination dimming control signal corresponding thereto, and transmits the generated signal to the LED dimming unit through the Bluetooth module.

FIG. 6 is a block diagram showing a control configuration for controlling the LED dimming unit according to the sensing of the sensor device in the local controller according to the embodiment of the present invention.

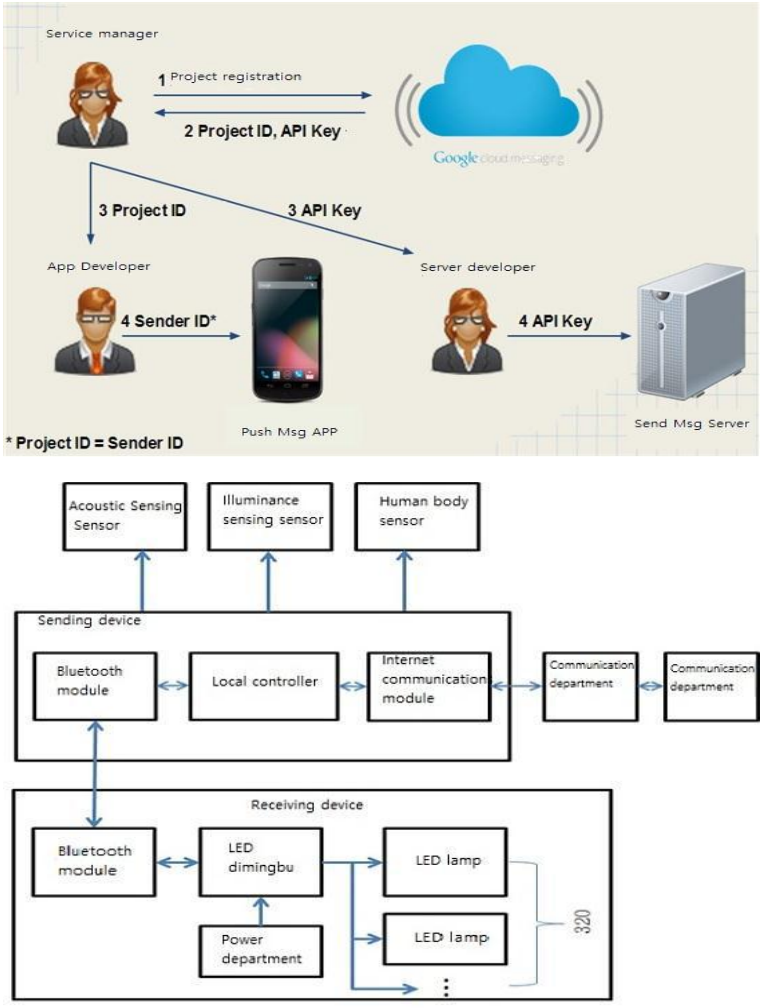

Figure 6. Integrated management block diagram

4.2 Implementation of Hardware System Design

Entry TCP.cs

```
//Connect to control system at access (use Begin ~ for asynchronous socket communication)
public void arduinoBell_Received(object sender, SerialDataReceivedEventArgs e)
{
      if (arduinoBell.serialPort.ReadChar() == Constants.buttonClick)
      {     // Because it is a connection and it should not be connected, it is pressed once and then the state is changed.
            if (clientSocket == null && bthEnum == EntryEnum.WAITING)
            {
                  bthEnum = EntryEnum.HOME_WAITING;
                  newsock = new Socket(AddressFamily.InterNetwork,
                  SocketType.Stream, ProtocolType.Tcp);
                  IPEndPoint iep = new IPEndPoint(IPAddress.Parse(homeIP), portNum);
                  BellForm.ChangeLabel("Waiting for connection...");
                  newsock.BeginConnect(iep, new AsyncCallback(Connected), newsock);
            }
             else if (clientSocket != null && bthEnum == Entry.HOME_WAITING)
            {
                  byte[] message = Encoding.ASCII.GetBytes("Belling");
                  clientSocket.BeginSend(message, 0, message.Length, SocketFlags.None,
                                          new AsyncCallback(SendData), clientSocket);
            }
      }
}
private void Connected(IAsyncResult iar)
{
      clientSocket = (Socket)iar.AsyncState;
      try//Connection success
      {
            clientSocket.EndConnect(iar);
            BellForm.ChangeLabel("Connecting...");

            bthEnum = EntryEnum.HOME_WAITING;

            byte[] message = Encoding.ASCII.GetBytes("Connect");
            clientSocket.BeginSend(message, 0, message.Length, SocketFlags.None,
                                    new AsyncCallback(SendData), clientSocket);
       }

(Skpped in details)

    ScanCountdown sCount = new ScanCountdown();
            sCount.ShowDialog();

            ConfigImgValue();

           // Save images stored in clipboard in png format
            GetClipboadImg.ProcGetClipboardImg(Constants.cardDir + imgValue + ".png");
           // Extract member's cell number
            string phoneNum = GetPhoneNum.startGetPhoneNum(Constants.cardDir +
                                                            imgValue + ".png");

            byte[] message = Encoding.ASCII.GetBytes(phoneNum);
            remote.BeginSend(message, 0, message.Length, SocketFlags.None,
                              new AsyncCallback(SendData), remote);
}
```

All communications are asynchronous for other operations of the program. So Begine ~ will end with End ~. To send a string, use Encoding.ASCII.GetBytes. To receive a byte from Recv and make it a string, Encoding.ASCII.GetString is used.

The user interface screen for the integrated monitoring of the remote LED lamp shows the state of the LED lamp (ID, control box ID) indicating ON / OFF of the login screen, start screen and LED lamp. It is possible to grasp the operation status and the current status of the power through the communication status screen showing the communication status with the control box in which the transmitting apparatus is installed and the control history inquiry screen. Also, user interface screen for integrated monitoring of remote LED lamp and mobile device connecting with wired and wireless are provided, enabling real-time monitoring and tracking of LED lamp status of each floor in mobile devices.

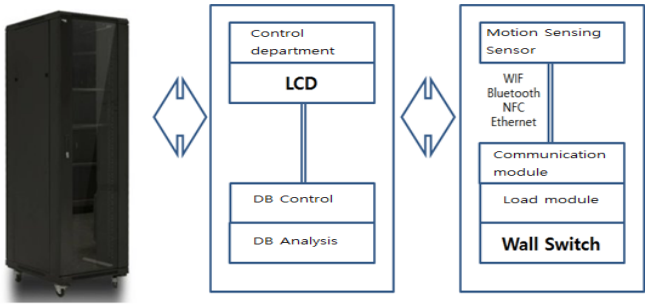

Figure 7. Configuring Integrated Control

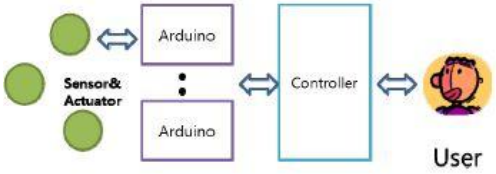

Figure 8. Smart control model

We enable communication between mobile (Android) and Arduino for lighting and door management, and enable direct control by the user. Arduino is an open-source based microcontroller and has the advantage of being easy to operate, making it more effective for controlling many sensors (see Figure 7). As shown in Fig. 8, there are two methods of communication between mobile and adunino: Bluetooth (short range) and web (long range). In this paper, both short range and long range are used.

As shown in Figure 9, the web method uses a server written in PHP.

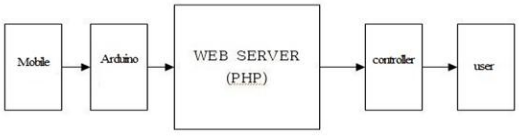

Figure 9. Telecommunication model

By using Web Server, it can control (closed, open, etc.) from the mobile, store the sensor value of Arduino, and help users to control what they want based on these values.

5. Conclusion

Due to the recent development of smart grid, IOT, and sensor technology, it is expected that the use environment of the building, such as school, public place, house, and office building, will change. Recently, the sensors required in the smart home environment have various functions, so that it is possible to control and record information notices and appointment notices.

Especially, in this study, it was found that about 70% of indoor accidents occurred in the room under the background that indoor accidents are more important than indoor accidents. Therefore, in this paper, we propose a system that controls the interior lighting and access control according to access control, so as to communicate with the outside in case of an accident, and a system that reasonably controls access for accident handling.

Also, by integrating control by using daycare facility access control and lighting system, entrance and exit management can approve or deny visitor access. Smart integrated management is expected to be able to prevent indoor areas vulnerable to safety accidents.

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