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A System for Automated Notification and Monitoring for an Empty Room with Lights On

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Abstract **— This paper provides a low cost-effective, flexible control and monitoring system with the aid of an Arduino microcontroller and node server with IP connectivity for access to and control of equipment and devices remotely using Android-based smartphone app. The proposed system does not require a dedicated server PC with respect to similar systems and offers a new communication protocol for monitoring and controlling the home environment with more than just switching functionality. The smart interfaces and device definitions to ensure interoperability between android devices from various manufacturers of electrical equipment, meters and Smart Energy enables products to allow manufactured. We introduced the proposed energy control systems design intelligent services for users and provides, we show their implementation, with smartphone.**

Keywords: Arduino UNO, Smart Lights, Automation, Android, Smartphone, Sensors, Light sensor, Temperature Sensor, PIR motion sensor, Empty room

1. INTRODUCTION

Intelligent management of the power system, facilitate the joint use the current and minimizes power loss during transmission and power consumption is highlighted by the global community, academic institutions, and State administration. Environment monitoring and device control allows new level of comfort in colleges or homes and it can also manage the energy consumption efficiently which in turns promotes the saving. Remote controlling of the devices offers many advantages to senior citizens and people with disabilities which helps them in being more autonomous and increasing quality of life. We have proposed a system that develops a Smart Control and Monitoring System by harnessing the power of IoTs at low-cost which provides flexible and scalable architecture for university automation. It will provide security, energy efficiency.

We propose to design and implement a system for automated notifications and real time monitoring of a lighted empty room. We implement the proposed system and develop related hardware and software. We are collaborating IoT, Cloud computing and Mobile Application Development. Our system will help the user to get notified about empty rooms with lights ON.

2. LITERATURE SURVEY

Exploiting features of Android mobile devices for saving energy applications which uses techniques like Arduino microcontroller. In this project by using Android application user can control energy systems like lights. After that control system based on Android smart phone introduced in 2014, preferred Techniques like PIC Controller. A user logs into the smart phone interface, and clicks the buttons gently to send message commands which will be transmitted to
home information Centre through the GSM network. Then the PIC processor recognizes the specified command, and controls the home appliance switches in the wireless radio frequency manner to achieve remote control of appliances
ultimately.

3. SYSTEM DESIGN

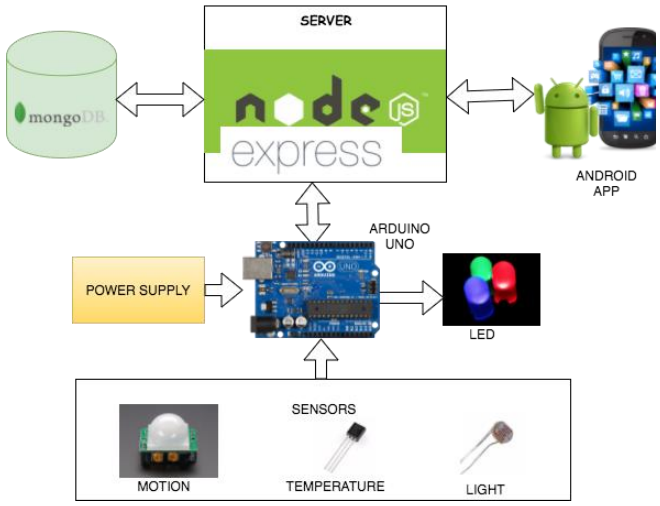

Figure 1: Architecture

3.1 Software Design

Technologies used in the software of the proposed architecture is as follows:

LAYERS IN ARCHITECTURE	Technology used
Front End	Android
Backend Server	Node.js and Express.js
Backend Deployment	Heroku
Database	MongoDB

Android Application: The android application is built on OS version 4.2, Jelly bean. It is supported by 95% of the Android devices as per May, 2017. This app connects to the device which is kept in a room to detect its emptiness with switched on lights. The app is made secured with Tokenization authentication model. The user first installs the app and registers the device with his email and password. Each time the user opens the app he must login into the app with his email and password. The credentials are checked in the database via the backend server and a token is generated. The user is now logged in using this token and sees the dashboard.

Using this app, the user can monitor the data in near real time. He can switch on and off the LED light easily and quickly from the mobile devices via a simple and comfortable GUI application. The system then acts and respond to these commands by taking actions per commands and gives the result to the user. The user gets a notification whenever the device detects an empty room with light on. The user can also see the result on Android mobile application from anywhere.

The following are the User Interface (UI) of the Android app.

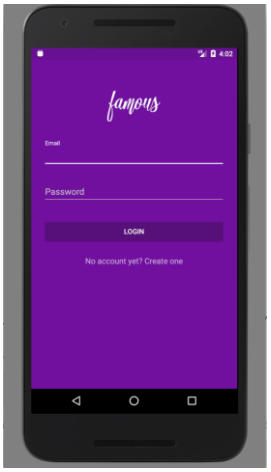

Figure 1: Login Activity

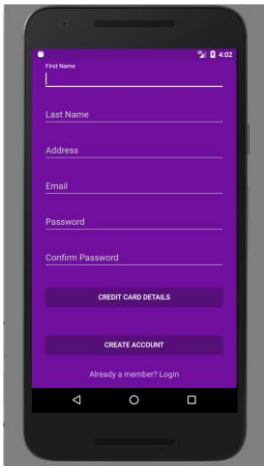

Figure 2: Buy Product Activity

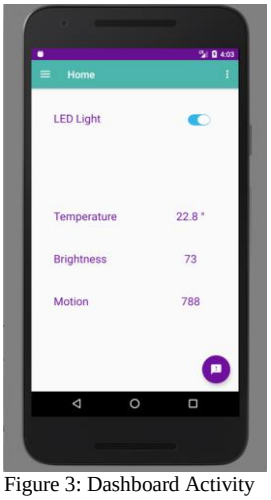

Figure 3: Dashboard Activity

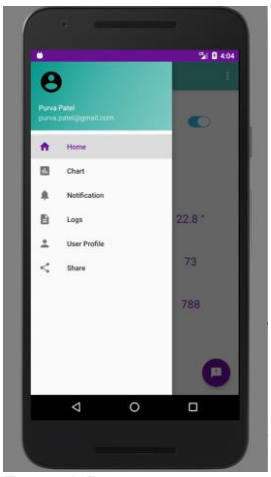

Figure 4: Drawer

Figure1: Chart Activity

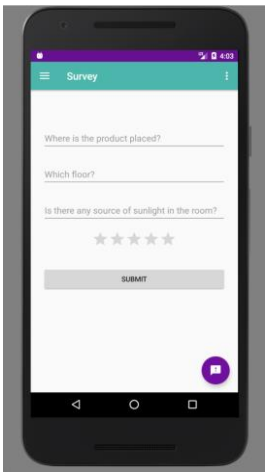

Figure 2: Survey Form Activity

Backend Server: The backend server is an Application Programming Interface (API) written in JavaScript using Node.js and Express.js frameworks. It is responsible to authenticate the user and generate the tokens. It also receives the data from the device and stores the values in the database. Communication from Android App to backend server, Database to backend server, and Device to backend server is done using REST APIs.

Libraries: The following libraries are used to implement the backend.

- Express
- Mongoose
- Java Web Token

Express: This is an open source library used to with node,js to create web APIs.
Mongoose: This is an open source library, responsible to connect to mongoDB. We can perform CRUD operation in mongoDB using Mongoose library.
JSON Web Token: This is an open source library used to generate a token. This token is used by the client application for authentication

Database: The database used in this system is MongoDB. MongoDB is a NoSQL database. It stores the data as JSON objects. The collections and its description are given the table.

COLLECTION	USE
Sensor Data	To store the sensor values from device
Users	To store user information like Name, email, password, address etc
LED Data	To store the state of LED
Notification	To store the state of empty room with lights on.

3.2 Hardware Design

Microcontroller:
Arduino UNO:
Arduino/Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

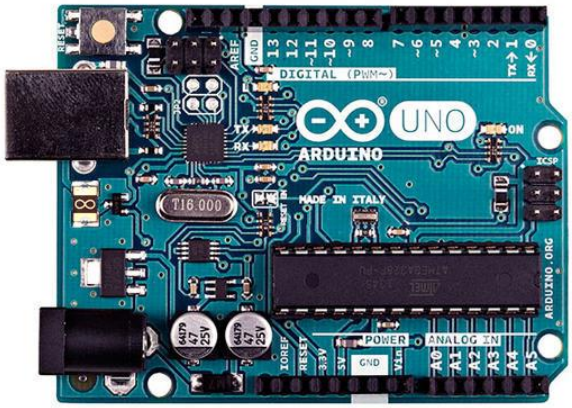

Figure 1: Arduino UNO

It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.
Table provides the technical specifications of Arduino Uno microcontroller.

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Table 1: Technical Specifications

Central controller (Arduino) receiving commands used to perform. You may connect to the Internet through an Ethernet shield mounted on the Arduino. On the user side, provides a portable interface to the system as a whole through an easy-to-use application. Can either be wired mobile device of the central control unit (through the USB cable, for example), or in connection with this wirelessly. At home or in the university, wireless connectivity can be

achieved by using the Ethernet shield on the central console. This way, you will be able to access the console, either locally or remotely through the Internet. In this case, client/server architecture is the one to choose, because the central console as a static entity that responds to requests from clients (mobile devices) (and sends notifications, as well as them eventually). Hence need for server (at the application level, any piece of code that can respond to client requests) is closely linked to the company. We'll use a simple Web server application running on Arduino that communicates via HTTP protocol with Web-based Android app.

Sensors:

Light sensor:
A Light Sensor is something that a robot can use to detect the current ambient light level - i.e. how bright/dark it is. There are a range of different types of light sensors, including 'Photoresistors', 'Photodiodes', and 'Phototransistors'. The sensor included in the BOE Shield-Bot kit, and the one we will be using, is called a Phototransistor. A photoresistor operates similarly to a phototransistor however it changes its resistance based on the amount of light that falls upon it. Photoresistors tend to be less sensitive, also.

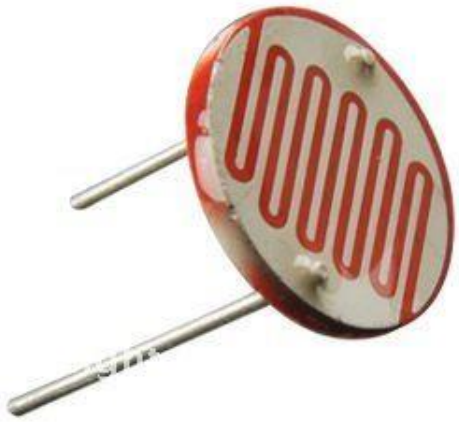

Figure 2: Light Sensor

PIR Motion sensor:
PIR sensors are more complicated than many of the other sensors explained in these tutorials (like photocells, FSRs and tilt switches) because there are multiple variables that affect the sensors input and output. To begin explaining how a basic sensor works, we'll use this rather nice diagram
The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.

Figure 3: PIR Motion Sensor

Temperature sensor:
Temperature Sensors measure the amount of heat energy or even coldness that is generated by an object or system, allowing us to “sense” or detect any physical change to that temperature producing either an analogue or digital output. There are many different types of Temperature Sensor available and all have different characteristics depending upon their actual application.

Figure 3: Temperature Sensor

Led Sensor:

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode that emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

Figure 4: LED sensor

Circuit Diagram:
The Arduino Uno board is connected to the power supply. The sensors are connected as per the circuit diagram on the bread board. 5V power supply is given to the bread board and the sensors from the Arduino board.

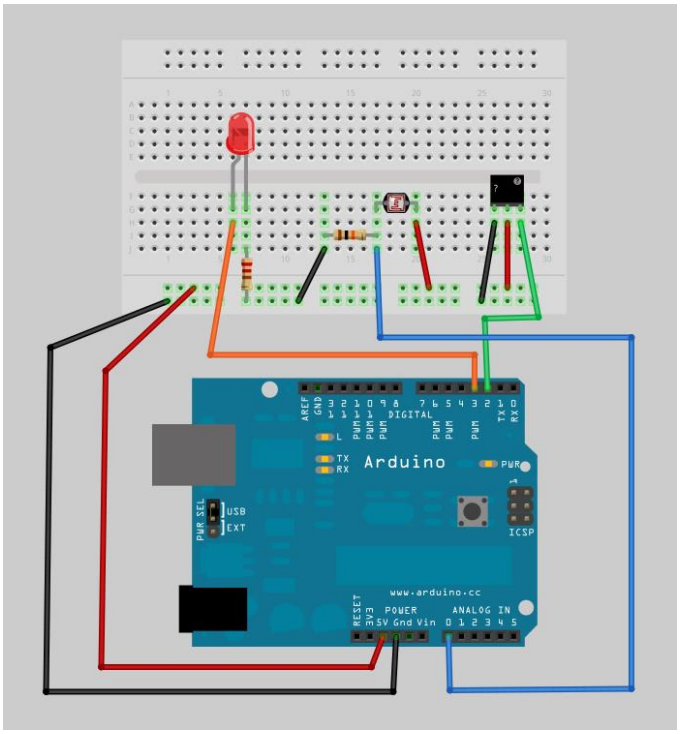

Figure 5: Circuit Diagram

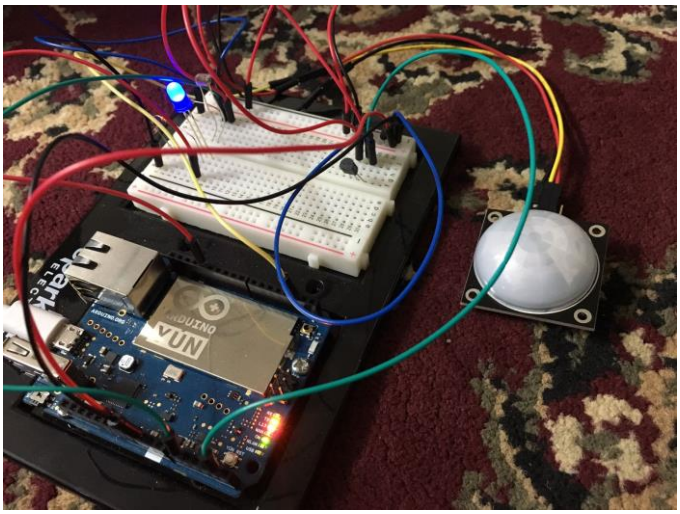

Figure 6: IoT Device

4. LIMITATIONS AND CHALLENGES

Some of the limitations in the proposed system are as follows:

- The Light sensor detect any source of light, for example. Sunlight, Room lights, Bulbs, Screen lights etc. Due to this the system assume that the light in the room is switched on. If the device is kept in a room that may contain sources of light other than the room light, then the system will assume that the light is

switched on. One of the common sources of light in a room would be sunlight coming from a window. So, the proposed system does not work accurately during day time.

- PIR motions sensors come with ranges of 10ft, 20ft and 30ft. Thus, any motion occurred outside this range might not be detected.
- If a person in a lighted room is sleeping, meditating, sitting idle or simply is not performing any motion then the system assume that the room is empty.

5. FUTURE SCOPE

To overcome the above limitation, researched can take up the following solutions:

- To accurately detect the source of light, machine learning can be implemented in the proposed system. A survey form can be implemented in the android app to get more information about the room like, on which floor the room is? How many sources of light does the room has? Etc.
- Higher range motion sensors can be implemented with respect to the size of the room.
- Using more sensors like sound sensor in the proposed system can help in accurately finding the empty room.

LIMITATIONS	SOLUTIONS
Daylight	Machine Learning
PIR Motion senses up to 30ft	Use high range sensors
Sleeping, Meditating, Sitting Idle etc. cannot be accurately detected	Use more sensors to detect an empty room accurately like sound sensor etc.

6. CONCLUSION

In this paper, we propose a new architecture for automated notification, monitoring and control system that uses a Android smartphone and implemented by Arduino UNO microcontroller board and low cost sensors like Temperature sensor, PIR motion sensor, Light sensor and LED sensor. The proposed architecture is used in a quite based web services in an interoperable application layer for communication between the Android application and the device. All Android-based smartphone, the Wi-Fi connection is the support built, the home access device to control. If the Internet is not possible, it can be access by used the 4G, LTE, 3G or 2G mobile system mobile. Future studies will use the commands for controlling the voice applications by implementing the home server.

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