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Smart Home Automation System Based on Li-Fi Technology

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Abstract: *In general, home automation means controlling the utilities and features of the household appliances. To achieve this most automation systems use Wi-Fi as a communication technology. But when it comes to Wi-Fi the overall setup costwill be higher and it also not possible to connect all the household appliances to the network. For that we had proposed a system called smart home automation system based on Li-Fi technology. Since its Li-Fi, a VLC, we can use our domestic household LED lights as a transmitting source. This system will control the power up function of the appliances. And the overall setup of this system is very simple on both the hardware and software sides. The specific light encoded data will be transmitted by the LEDs and decoded by photodiode at the receiver section. By implementing this Li-Fi technology in home automation will bring the new eraof automation with simple, speed, cost-effective and secure features. And this will be the dual benefits of both luminance and automation in a single implementationsetup. And on the security side also it will provide secure communication with theability to be impenetrable through physical objects because of the nature of light. Not only smart devices, every electrical device can be operated with this technology implementation.*

Key Word: *Home Automation; LI-FI; Sensor; Connection; Future*

I.INTRODUCTION

Li-Fi known as light fidelity was introduced first time by Prof. Harald Haas in July 2011 at TED Global Talk. Li-Fi is based on Visual Light Communication (VLC) that uses light emitting diodes (LEDs) to fully networked wireless systems. Li-Fi enables the electronic device to connect to the internet with no wire. In order to make a communication line between nodes, a Li-Fi will need a transceiver to transmit and receive the data.

This transceiver will have a modulation technique to make the LED enable to carry the data using the light. The emergence of Li-Fi is to overcome the shortage of the current technology. We all know that right now Wi-Fi is the most used technology to connect many devices to the internet. As time comes by, the use of internet based devices has increased. This increased the capacity of Wi-Fi is reduced due to the limitation of radio frequency resources.

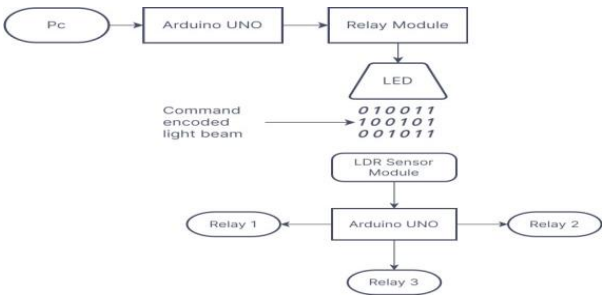
According toLi-Fi and Wi-Fi there are differences related to congestion, density, security, safety, and speed. The more Wi-Fi enabled devices there are, the more congestion may occur. In the technology of Wi-Fi we can't add more routers if the number of users is increased, while we can add the light in Li-Fi. Efficiency and safety of the internet are the dominating issues right now. The performance of Li-Fi is claimed to be better than the performance of Wi-Fi. The rate speed of Li-Fi is 1000 timesfaster than Wi-Fi. For safety of the internet, Li-Fi is more secure than the Wi-Fi based on the spread of the signal.

Li-Fi has a light characteristic that light cannot go through the wall. It is different from the signal that Wi-Fi can go through anywhere. Based on those two technologies, in a simple conclusion Li-Fi has more secure communication than Wi-Fi. The vulnerability exists if there is leakage in the wall while having indoor communication.

II. MATERIALS AND PROPERTIES

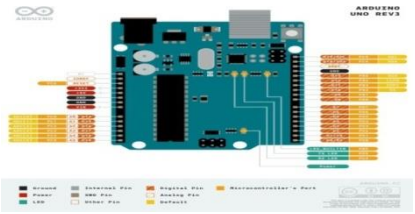
Li-Fi is an emerging technology in wireless communication. Because of its high speed data transferring capacity and cheaper deploying cost has raised the needs of it in every field of the world. Likewise the home is also one of them. Implementing this system will bring the new era of home automation. The detailed explanation and the working principle of the system isdiscussed under the upcoming topics.

Block Diagram:

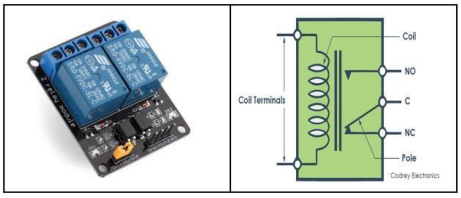


Arduino Uno Microcontroller:

ARDUINO UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output. AVR microcontroller Atmega328, 6 analogue input pins, and 14 digital I/O pins out of which 6 are used as PWM output. This board contains a USB interface i.e, USB cable is used to connect the board with the computer and Arduino IDE (Integrated Development Environment) software is used to program the board. The unit comes with 32KB flash memory that is used to store the number of instructions while the SRAM is 2KB and EEPROM is 1KB.



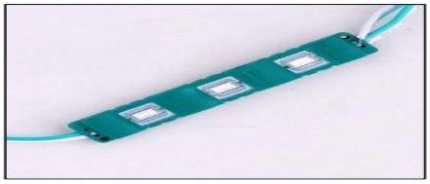
Relay Module:



A Relay is an electromechanical device that can be used to make or break an electrical connection. It consists of a flexible moving mechanical part which can be controlled electronically through an electromagnet, basically, a relay is just like a mechanical switch but you can control it with an electronic signal instead of manually turning it on or off.

When the circuit of the relay senses the fault current, it energises the electromagnetic field which produces the temporary magnetic field. This magnetic field moves the relay armature for opening or closing the connections. The small power relay has only one contact, and the high power relay has two contacts for opening the switch.

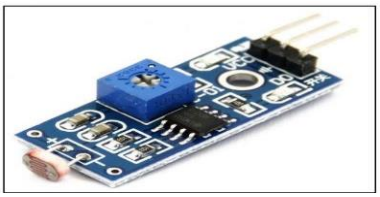
LED Lights (12v):



A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flows through it. LEDs have the ability to respond immediately which helps them to ON and OFF in a very quick manner. This ability of

LEDs made them a great light source of Li-Fi technology.

LDR Sensor Module:



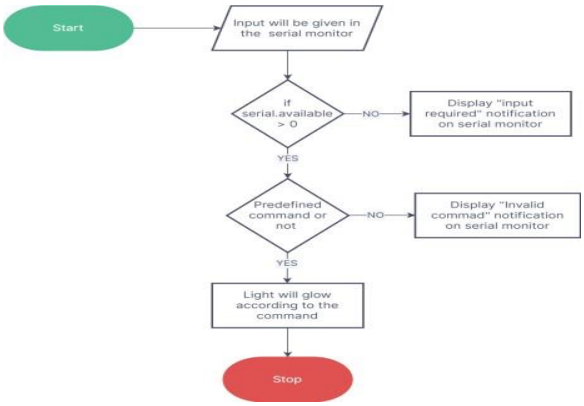
LDR sensor module is a low-cost digital sensor as well as analog sensor module, which is capable of measuring and detecting light intensity. This sensor also is known as the Photo resistor sensor. This sensor has an onboard LDR(Light Dependent Resistor), that helps it to detect light. This sensor module comes with 4 terminals.

Software Requirement:

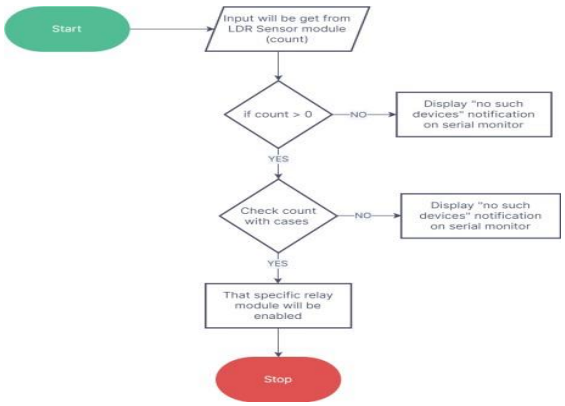
The Arduino Integrated Development Environment or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

III.RESULT

Transmitter Flowchart:



Receiver Flowchart:



Working Principle:

- After powering up the system, the system will be ready for the processing of the command that will be given.
- The command will be anything like, “Light ON”, “Fan ON”, “Light OFF” likewise.

- The command will be sent through the Tx serial monitor's send tab
- Once the command is entered, it will be checked by the Tx microcontroller and the specific block of code will be executed.
- The specific code is nothing but the combination of "degitalWrite HIGH" or "LOW".
- It calculates how many times the LED gets OFF. Using this count the receiver controller will check for thematches and will execute it.
- Here the execution is nothing but making the connected specific relay into ON or OFF according to the command.

The result of this system will be known by noticing the desired appliances turned ON by the relay. This relay is enabled by retrieving and processing the incident light beam which falls on the LDR sensor.

But in over setup we didn't connect any appliance to the relay and so the output will be known by seeing the enable indication light of that specific relay module.

Every light bulb can be converted into Li-Fi signal receptor to transfer data and we could proceed toward the cleaner, safer, greener and brighter future.

As we know that the airways are getting clogged day by day Li-Fi can offer a genuine and very efficient alternative.

IV. CONCLUSION

Even though this is a simple Li-Fi setup, while deploying we were faced with lots of issues. There is something that we need to make sure before starting the transmission. And those are discussed below.

- First thing is choosing the right LED. Initially I had chosen a 5mm LED but it isn't that bright.
- At the same time, Arduino can't deliver more than 5v. So if you need to control above 5v devices you should need a relay or MOSFET module.
- You can use a MOSFET module at both sides if you want to connect a high voltage load instead of a relay.
- If you are demoing this project means use a 12v or higher as per your load. But it's better if you make a connection with household AC with the appropriate voltage regulator circuit.
- You can use any kind of photodiode, but depending on that the code will be changed.
- And also we can add a Wi-Fi module to the setup if you want to connect to the internet. But otherwise it's optional.
- You can also add other peripheral devices like sensors and others per the need. And also a computer software that is capable of controlling the whole setup.

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