International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099

VOL 1 ISSUE 3 (2017) PAGES 38 - 45

Received: 1/03/2017. Published: 13/03/2017

SMART INDUSTRIAL AUTOMATION SYSTEM ENHANCED WITH VISIBLE LIGHT COMMUNICATION (VLC) AND IOT

[1]R.Shamili, [2]R.Soni, [3]S. Santhanalakshmi,[4]M.Sudhakaran,
[1,2,]Dept of EEE, GTEC Engg. College, Vellore,
[3]Asst. Prof, Dept of EEE, GTEC Engg. College, Vellore,
[4]Associate Prof, Dept of EEE, GTEC Engg. College, Vellore.

ABSTRACT

VLC is more secure against hacking, as light cannot penetrate through walls and also offers high data rates, as compared with conventional RF based wireless technologies, such as Wi-Fi and Bluetooth. With various attractive benefits from VLC, smart Industry can be implemented using VLC as it would deliver safer, more secure and scalable smart industry. Infrared (IR) based device control is common in consumer electronics and equipment. However, the use of IR limits versatility in smart industry technologies compared with VLC, as VLC usually offers illumination plus wireless connections and more diverse control for smart home devices.

Keywords - PIC microcontroller, PIR sensor, Temperature sensor, LCD, Ethernet controller, Li-fi, LM 35 module.

1.INTRODUCTION

Li-Fi and Wi-Fi are quite similar as both transmit data electromagnetically. However, Wi-Fi uses radio waves while Li-Fi runs on visible light. As we now know, Li-Fi is a Visible Light Communications (VLC) system. This means that it accommodates a photo-detector to receive light signals and a signal processing element to convert the data into 'stream-able' content.An LED light bulb is a semi-conductor light source meaning that the constant current of electricity supplied to an LED light bulb can be dipped and dimmed, up and down at extremely high speeds, without being visible to the human eye. For example, data is fed into an LED light bulb (with signal processing technology), it then sends data (embedded in its beam) at rapid speeds to the photo-detector (photodiode).The tiny changes in the rapid dimming of LED bulbs is then converted by the receiver' into electrical signal. Depending upon the temperature and motion, electrical appliances can be controlled through LI-FI automatically. According to the status of temperature and motion sensor, we can control the electrical appliances manually through webpage using IoT. The respective data will be displayed in the LCD.VLC used in long range communication. No data loss in VLC.

2. PROPOSED METHOD

As an alternative technology to congesting RF bands for a short range communication, Visible Light Communication (VLC) has been introduced. VLC technology is one of the advanced optical wireless communication technologies, in which light in the visible region

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099

VOL 1 ISSUE 3 (2017) PAGES 38 - 45

Received: 1/03/2017. Published: 13/03/2017

(375 780 nm in wavelength) is used as a medium for data transmission. we are controlling the electrical appliances through LI-FI as well as IoT. The system consists of automatic and manual control of the electrical appliances. Temperature sensor is used to measure the temperature and PIR sensor used to measure the motion of the object. Depending upon the temperature and motion, electrical appliances can be controlled through LI- FI automatically. In the mean time, we can control the appliances manually through IoT using Ethernet cable. The respective data will be also displayed in the LCD. VLC offers the advantage of a communications channel in an unregulated. But the challenges of standardization will require cooperation and agreement form a number of bodies however, success should bring a low-cost high data-rate infrastructure that can increase wireless capacity substantially.

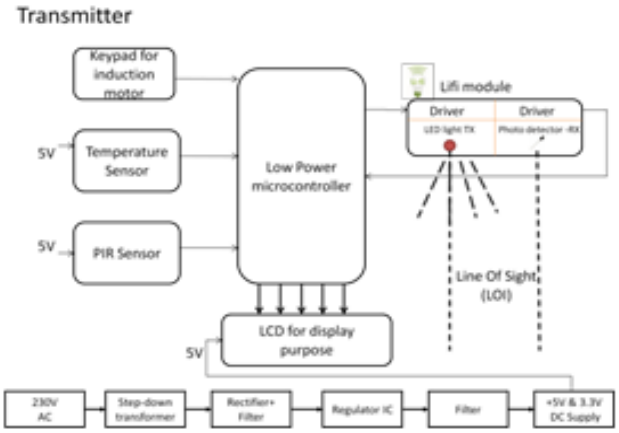

Fig.1. Block Diagram Of Transister section

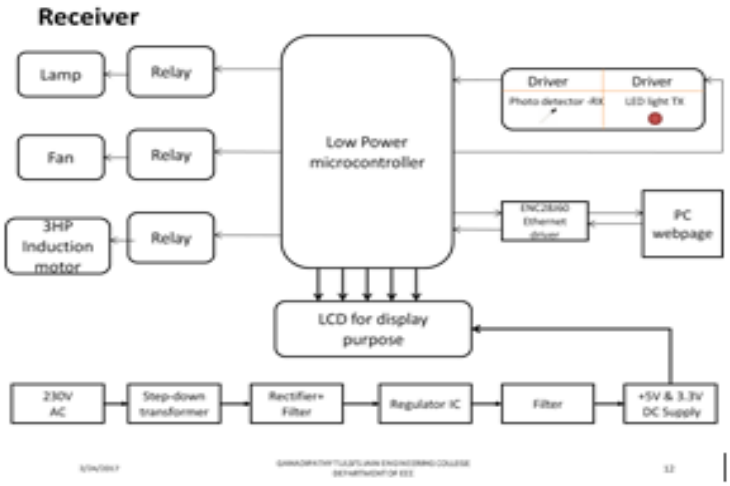

Fig.2. Block Diagram Of Receiver Section

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099

VOL 1 ISSUE 3 (2017) PAGES 38 - 45

Received: 1/03/2017. Published: 13/03/2017

3.DESIGN AND IMPLEMENTATION

A.PIC MICROCONTROLLER

Peripheral Interface Controller (PIC) was originally designed by General Instruments. In the late 1970s, GI introduced PIC 1650 and 1655 – RISC with 30 instructions.PIC was sold to Microchip Features: low-cost, self-contained, 8-bit, Harvard structure, pipelined, RISC, single accumulator, with fixed reset and interrupt vectors. Reason for using pic

Variety of choices (8-bit to 32-bit)
Affordable (Low Cost)
Low Power
Reasonable Size
Convenient Packaging
Through Hole (Dip)
Surface Mount (SMD)

B. LCD

I/O lines. For a 4-bit data bus it only requires the supply lines plus seven extra lines. When the LCD display is not enabled, data lines are tri-state which means they are in a state of high impedance (as though they are disconnected) and this means they do not interfere with the operation of the microcontroller when the display is not being addressed.

C. Li-Fi

Light Fidelity or Li-Fi is a Visible Light Communications (VLC) system running wireless communications travelling at very high speeds. Li- Fi uses common household LED (light emitting diodes) light bulbs to enable data transfer, boasting speeds of up to 224 gigabits per second. Li-Fi and Wi-Fi are quite similar as both transmit data electromagnetically. However, Wi-Fi uses radio waves while Li-Fi runs on visible light. As we now know, Li-Fi is a Visible Light Communications (VLC) system. This means that it accommodates a photo-detector to receive light signals and a signal processing element to convert the data into 'stream- able' content. An LED light bulb is a semi- conductor light source meaning that the constant current of electricity supplied to an LED light bulb can be dipped and dimmed, up and down at extremely high speeds, without being visible to the human eye. For example, data is fed into an LED light bulb (with signal processing technology), it then sends data (embedded in its beam) at rapid speeds to the photo-detector (photodiode). The tiny changes in the rapid dimming of LED bulbs is then converted by the 'receiver' into electrical signal. The signal is then converted back into a binary data stream that we would recognize as web, video and audio applications that run on internet enables devices.

D. PIR SENSOR (HC-SR501)

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099

VOL 1 ISSUE 3 (2017) PAGES 38 - 45

Received: 1/03/2017. Published: 13/03/2017

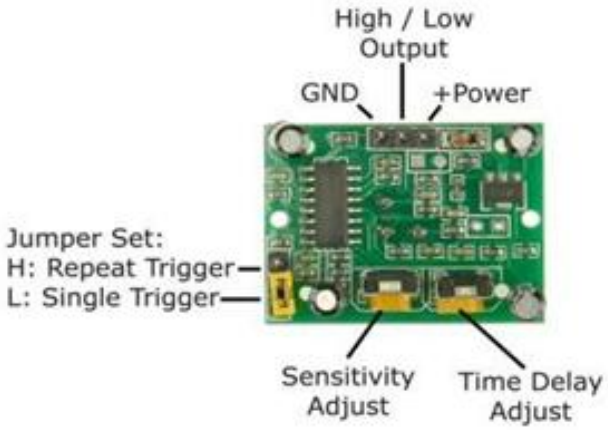

Fig.3. PIR Motion Detector

Electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs.The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom, animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. LCD displays designed are inexpensive, easy to use, and it is even possible to produce a readout using the 8 x 80 pixels of the display. For a 8-bit data bus, the display requires a +5V supply plus 1.

TEMPERATURE SENSORS (LM35 MODULE)

The LM35 series are precision integrated circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099

VOL 1 ISSUE 3 (2017) PAGES 38 - 45

Received: 1/03/2017. Published: 13/03/2017

F. ENC28J60 ETHERNET CONTROLLER

The ENC28J60 is a stand-alone Ethernet controller with an industry standard Serial Peripheral Interface (SPI™). It is designed to serve as an Ethernet network interface for any controller equipped with SPI. The ENC28J60 meets all of the IEEE 802.3 specifications. It incorporates a number of packet filtering schemes to limit incoming packets. It also provides an internal DMA module. for fast data throughput and hardware assisted IP checksum calculations. Communication with the host controller is implemented via two interrupt pins and the SPI, with data rates of up to 10 Mb/s. Two dedicated pins are used for LED link and network activity indication. With the ENC28J60, two pulse transformers and a few passive components are all that is required to connect a microcontroller to a 10 Mbps Ethernet network.

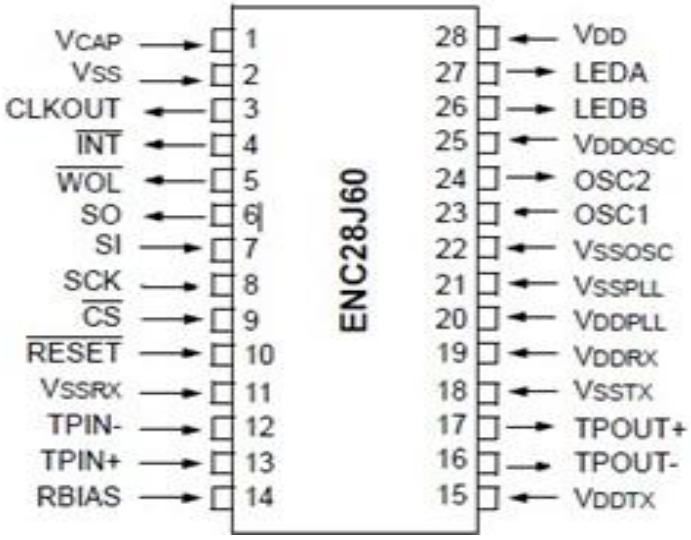

Fig.4. Pin Diagram

REGULATED POWER SUPPLY

Almost all electronic devices used in electronic circuits need a dc source of power to operate. The dc power supply is typically connected to each and every stage in an electronic system. It means that the single requirement common to all phases of electronics is the need for a supply of dc power. For portable low-power systems batteries may be used, but their operating period is limited. Thus for long time operation frequent recharging or replacement of batteries become much costlier and complicated. More frequently, however, electronic equipment is energized by a power supply, derived from the standard industrial or domestic ac supply by transformation, rectification, and filtering. Regulated power supply is an electronic circuit that is designed to provide a constant dc voltage of predetermined value across load terminals irrespective of ac mains fluctuations or load variations. Or in other words it converts unregulated AC into a constant DC. Its function is to supply a stable voltage (or less often current), to a circuit or device that must be operated within certain power supply limits. The output from the regulated power supply may be alternating or unidirectional, but is nearly always DC.

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099

VOL 1 ISSUE 3 (2017) PAGES 38 - 45

Received: 1/03/2017. Published: 13/03/2017

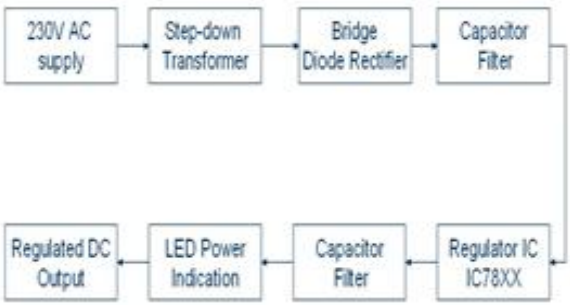

Fig.5. Block Diagram Of RPS

Source/Line Regulation – In the block diagram, the input line voltage has a nominal value of 230 Volts but in practice, here are considerable variations in ac supply mains voltage. Since this ac supply mains voltage is the input to the ordinary power supply, the filtered output of the bridge rectifier is almost directly proportional to the ac mains voltage.

Output Impedance – A regulated power supply is a very stiff dc voltage source. This means that the output resistance is very small. Even though the external load resistance is varied, almost no change is seen in the load voltage. An ideal voltage source has an output impedance of zero.

Ripple Rejection – Voltage regulators stabilize the output voltage against variations in input voltage. Ripple is equivalent to a periodic variation in the input voltage. Thus, a voltage regulator attenuates the ripple that comes in with the unregulated input voltage.

4. RESULT AND OUTPUT

The smart industrial automatic and manual control of the electrical appliances is archieved through LI- FI as well as IOT. Temperature sensor is used to measure the temperature and PIR sensor used to measure the motion of the object. Depending upon the temperature and motion, electrical appliances can be controlled through LI-FI automatically. In the mean time, we can control the appliances manually through IOT using Ethernet cable. The respective data will be also displayed in the LCD. The output of our project is given below:

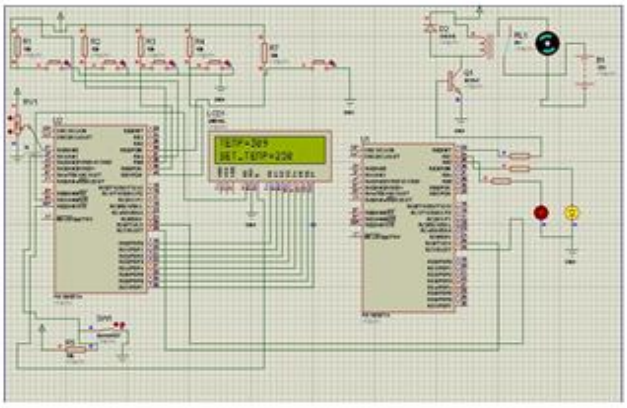

Fig.6. Simulation Output

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099
VOL 1 ISSUE 3 (2017) PAGES 38 - 45
Received: 1/03/2017. Published: 13/03/2017

Fig.7. Industrial Automation System Enhanced With Visible Light Communication(VLC) And IoT

CONCLUSION

VLC is more secure system of hacking, as light cannot penetrate through walls and also offers high data rates, as compared with conventional RF based wireless technologies, such as Wi-Fi and Bluetoth. This technology is one of the advanced in optical wireless communication technologies, and it is mostly used for light communication. Smart Industry can be implemented using VLC system as it would deliver safer, more secure and scalable smart industry. We are controlling the electrical appliances through LI-FI as well as IoT. The system consists of automatic and manual control of the electrical appliances. Temperature sensor is used to measure the temperature and PIR sensor used to measure the motion of the object. Depending upon the temperature and motion, electrical appliances can be controlled through LI- FI automatically. In the mean time, we can control the appliances manually through IoT using Ethernet cable. The respective data will be also displayed in the LCD.

REFERENCES

[1] A. Willig, K. Matheus, and A. Wolisz, "Wireless technology in industrial networks," Proc. IEEE, vol. 93, no. 6, pp. 1130–1151, Jun. 2005.

[2] T. M. Chan, K. F. Man, K. S. Tang, and S. Kwong, "A jumping-genes paradigm for optimizing factory WLAN network," IEEE Trans. Ind. Informat., vol. 3, no.
1, pp. 33–43, Feb. 2007.

[3] S. Ivanov, E. Nett, and S. Schemmer, "Planning available WLAN in dynamic production environments," in Proc. 7th IFAC Int. Conf. Fieldbuses and Networks in Industrial and Embedded Systems (FET'2007), Toulouse, France, Nov. 2007.

[4] E. Tovar and M. Alves, "Real-time communications over wired/wireless PROFIBUS networks supporting inter-cell mobility," Comp. Netw., vol. 51, no. 11, pp.
2994–3012, Aug. 2007.

[5] G. Schafer, Security in Fixed and Wireless Networks—An Introduction to Securing Data Communications. Chichester, U.K.: Wiley, 2003.

[6] D. Dzung, M. Naedele, T. P. v. Hoff, and M. Crevatin, "Security for industrial communication systems," Proc. IEEE, vol. 93, no. 6, pp. 1152–1177, Jun.
2005.

[7] J.-P. Thomesse, "Fieldbus technology in industrial automation," Proc. IEEE, vol. 93, no. 6, pp. 1073–1101, Jun. 2005.

[8] R. Zurawski, Ed., The Industrial Communication
Technology Handbook. Boca Raton, Florida: CRC, 2005.

[9] J. Jasperneite and P. Neumann, "Measurement, analysis and modeling of real-time source data traffic in factory communication systems," in Proc. 2000 IEEE Int. Workshop Factory Communication Systems (WFCS), Sep. 2000.

[10] D. O'Brien, H. L. Mihn, L. Zeng, G. Faulkner, K. Lee, D. Jung, Y. Oh, and E. T. Won, "Indoor Visible Light Communications: Challenges and Prospects:, proceedings SPIE, vol. 7091, 2008.

[11] Sridhar Rajagopal, Richard D. Roberts, Sang-Kyu Lim, "IEEE 802.15.7 Visible Light Communications: Modulation Schemes and Dimming Support", IEEE Communication Magazine, vol. 50, issue: 3 pp: 72-82,
2012.

[12] J.R. Moyne and D. M. Tilbury, "The Emergence of industrial control networks for manufacturing control diagnostics and safety data," In Proc. of IEEE , vol. 95, no. 1, pp. 29-47, Jan. 2007.

[13] M. Kavehrad, "Sustainable Energy-Eficient Wireless Applications Using Light," IEEE Commun. Mag., vol. 48, no. 12, Dec. 2010, pp. 66-73.

[14] A. Bonivento, C. Fischione, L. Necchi, F. Pianegiani, and A. Sangiovanni-Vinecenteli, "System level design clustered wireless sensor networks," IEEE Trans. Ind. Inormat., vol 3, no. 3, pp. 202-214, Aug. 2007.