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A MODERN HEALTH CARE SYSTEM USING VISIBLE LIGHT COMMUNICATION TECHNOLOGY

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Abstract - This project describes a Modern health care system using visible light communication technology. The present scenario of monitoring patients manually in ICU is where, a lot of paper work and a labor is needed for careful observation. There might be a possibility of errors. Now, the technology is faster and accurate than the human eye can follow. Although, Wi-Fi is introduced in Bio-medical applications, it cannot be used because of RF radiations impact on patient's health and medical instruments. The purpose of the paper is to explain a modern approach to monitor patients in ICU and update their details digitally. VLC is a useful technology with high speed, better bandwidth, high efficiency, availability and is more secure. Our proposed work minimizes paper work, saves time and maintains the records of patients with high security. The regular examinations status by doctors and periodic assessment details by nurses are updated digitally. It includes the facility of viewing the patient's results and status by the patient's family in their own mobile phones. Hence, VLC based patient monitoring system is highly compatible and has better scope and benefits in future.

Keywords: VLC, Wi-Fi, RF, ICU.

I. INTRODUCTION

Wireless communication schemes like Wi-Fi especially uses radio/micro wave frequencies for data transmission, primarily because of the possibility of high sensitivity receivers and ability to provide broad coverage at low frequencies and high frequency line of sight communication. But, radio frequency can support only a finite bandwidth due to confined spectrum availability. The idea behind this VLC (Visible Light communication) scheme is transmission of 'Data through illumination'. The intensity of the LEDs is varied by alternating the current passed through them at very high speed. However, the human eye cannot recognize this change and the LEDs appear to have a constant intensity.

The usage of RF in health care world, would have a profound impact on the health of the patients. Also, Electromagnetic Interference (EMI) would be threatening to the expensive medical instruments since RF devices such as mobile phones are restricted to use near emergency rooms and Intensive Care Unit (ICU) [6]. At present, the health care units a lot of paper work for monitoring patients record regarding patient's health condition, their details medical prescriptions, etc. But, if the paper is lost it is very difficult together all this information. As the technology grows these are performed using Wi-Fi which is not advisable to use in ICU [4].The medical world today faces two basic problems when it comes to patients monitoring, firstly the need of health care providers present bedside the patient and secondly the patient is restricted to bed and wired to large machines [10]. Now a day, health and patient monitoring is very tedious job to do. The monitoring personnel have to watch patients continuously who are admitted in ICU. Doctors need to be more conscious about patient health status and should continuously update their health information [7].

The solution for these issues comes out with Visible Light Communication (VLC), which is the promising technology which can replace the indoor usage of Wi-Fi at present. In this we introduce a health monitoring system consisting of wearable devices (different sensors) that will continuously monitor the health of the patient and update their details digitally. This minimizes paper work and saves time. Therefore VLC technology would be a strong candidate for clinical data transmission in health care. VLC would be the best suited for efficient wireless data services with no RF radiation.

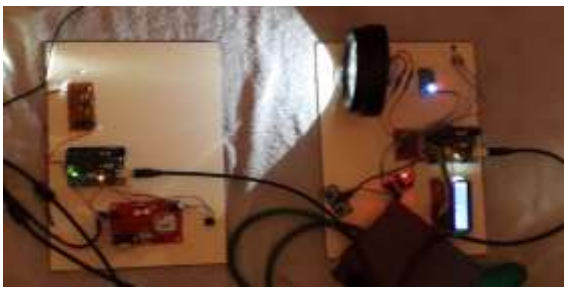
II. VLC

VLC is a short range optical wireless communication technology which is used for both illumination and data communication. It uses the spectrum of visible light from 380 nm to 780 nm. VLC system consist of transmitter which uses white LEDs as an optical source, free space(air) as the transmission medium and photo detector at receiver. VLC communication acts as a supplement to the present RF communication as it has the advantages of bandwidth low power consumption visibility, free Electro Magnetic Interference (EMI) and radiation hazards.

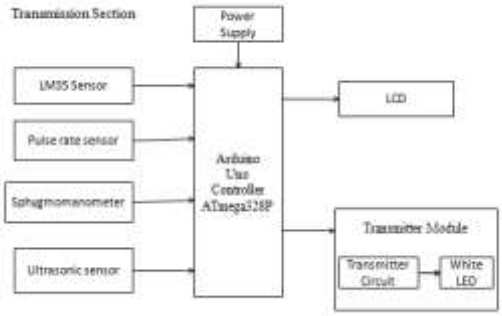
III. SYSTEM DESIGN

The prototype model gives a brief description of how medically related equipment is interfaced and processed using Visible Light Communication technology. This model consists of two sections which are transmitting and Receiving sections. Both the sections have their own significant purposes for this project, which is enlisted below.

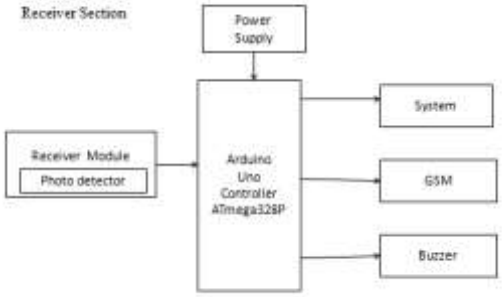
Prototype Model:



BLOCK DIAGRAM



RECEIVER SECTION



IV. WORKING PRINCIPLE

Transmitting Section:

The task of transmitter is to convert digital data into visible light. An LED was a suitable component because of its relatively linear relation between current and light intensity. The general idea is to modulate the light intensity of the LED i.e., the intensity of the light corresponds to the symbol transmitted.

In the transmitter side, the data is first converted to binary through an ADC and then fed into a LED driver circuit which is controlled by a signal processor. The LED driver works on the On-Off Keying modulation where we can encode data using this technique. The LED intensity is modulated so rapidly that human eye cannot notice, so the output appears constant .After this the high illumination LED blinks at high speed and transmits the data as optical pulses through the wireless channel at a baud rate of 9600 serial transmission. More sophisticated techniques could dramatically increase VLC data rate.

Receiving Section:

At the receiver end, the photodiode is a semiconductor converting light into an electrical current. Or in the other words, it is used to detect data transferred. When the photo diode detects light, the current through the resistor increases Therefore increasing the voltage drop across the resistor. Similarly when there is no light falling on the photo diode, the voltage drop across the resistor decreases.

Then, the photo transistor used to enhance light as it travels through it and allow the light to reach the phototransistor's sensitive parts. A phototransistor generally has an exposed base that amplifies the light that it comes in contact with.

The voltage across the resistor is fed into a comparator to ensure a proper HIGH or LOW state corresponding to the whether the LED is ON or OFF. An op-amp LM324 with threshold voltage of 1.2V is used as the comparator.

V. SYSTEM ANALYSIS:

Detailed description and working analysis of every component are explained.

Hardware Requirements:

1. Arduino Uno Board (2).

2. LM35 Sensor

3. Sphygmomanometer.

4. Pulse Rate Sensor

5. Ultrasonic Motion Detector Sensor

6. LCD

7. GSM

8. Buzzer

Software Requirements:

1. Arduino IDE

2. Embedded C.

3. Proteus8 Professional.

VI. WORKING ANALYSIS

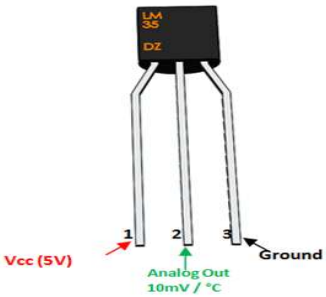
1. Arduino Uno (ATmega328P):

Arduino Uno is a microcontroller board based on the ATmega328P.It has Atmega16U2 ,which is programmed as a

USB-to-serial converter. Open source and it is a extensible hardware. Cross platform and simple clear programming environment.

2. LM35 Sensor

A temperature sensor is a thermocouple or a resistance temperature detector (RTD) that gathers the temperature from a source and alters the collected information into understandable type for an apparatus (LCD)or an observer. The output voltage of LM35 is linearly proportional to the Celsius (Centigrade) temperature.



3. Sphygmomanometer:

Blood pressure (BP) is the pressure exerted by circulating blood on the walls of blood vessels, and is one of the principal vital signs. The digital output will be displayed as whether the Blood Pressure of the patient is normal or abnormal in the LCD.

4. Pulse Rate Sensor:

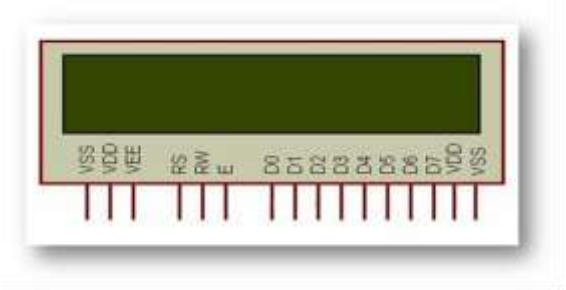
It works on the principle of light modulation by blood flow through finger at each pulse. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It gives instant output digital signal for directly connecting to microcontroller.

5. Ultrasonic Motion Detector Sensor:

This ultrasonic motion detector uses a technique that is based on a frequency shift in reflected energy to detect a movement or a change in position. It can be used in dark environments and not affected by color of objects. It have greater accuracy.

6. LCD

LCD (Liquid Crystal Display) screen is an electronic display module. A 16x2 LCD display is used here an it is a 4 bit micro controller. LCD with two controller has 16 pins (2 pins are extra in both for back-light LED connection).



7. GSM

GSM stands for **G**lobal **S**ystem for **M**obile Communication. It is a digital cellular technology used for transmitting mobile voice and data services. If the any parameter of the patient is abnormal, by using GSM we can send the message or information to the respective person or doctor.

8. Buzzer

A buzzer is an electrical device that is used to make a buzzing sound for example, to attract someone's attention. Here we used for emergency condition. The buzzer will get ON when the patient goes to an abnormal condition.

1. Arduino UNO

The Arduino UNO can be programmed with Arduino software (IDE).The ATmega328 on UNO board comes preprogrammed with a boot loader that allows to upload new code it.

2. Embedded C

It is a set of language extensions for the C programming language in which we used to code it.

3. Proteus8 Professional

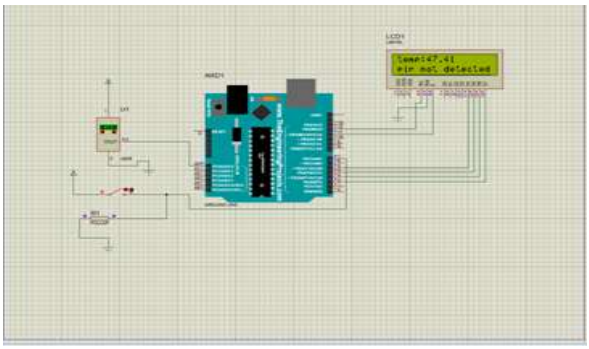
Proteus8 professional is software which can be used to draw schematics, PCB layout, Code and even simulate the interaction between the software running on a microcontroller and any analog or digital electronics connected to it.

VII. SIMULATION RESULTS

A sample layout of the working system is simulated by Proteus 8 Professional Simulation. The simulation is carried out by using two sensors one is the temperature sensor (LM35) and other is the PIR (Passive Infra Red) sensor which is the motion detector sensor. The whole setup is programmed by Arduino IDE(Integrated Development Environment).The program is written as the Arduino Uno Board taking input from the sensor and the output is displayed through LCD (Liquid Crystal Display).

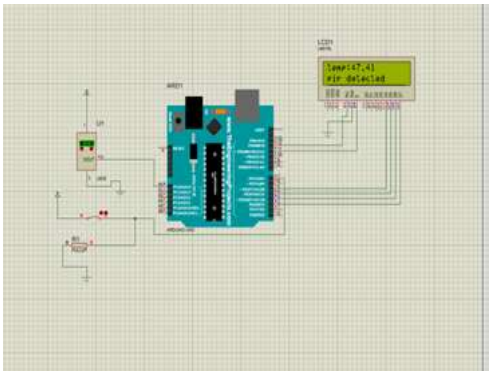
Part I Simulation:

Figure 1shows the first part of our simulation that is first the program is loaded second by clicking run button at the bottom the setup beings to work. In the LCD as a part of output the temperature is displayed and in the second line the status of PIR detector is mentioned. In the below figure 1 it is indicated as the PIR sensor is not detected.



Part II Simulation:

Below figure 2 is same as the part-I simulation with the changes that in this case the PIR sensor status is displayed as detected. This status is achieved by clicking the switch button on the software simulation screen. If we release this switch button the status will change.



VIII. CONCLUSION

We deal with the process of communicating without internet. The model exhibits the prototype for alert systems in patients Health Monitoring. Here, as the sensors provide us with the abnormal conditions of the patients, the transmitter (LED) sends the data alert to the receiver (photo detector).When the message is received, it gets stored in the receiver side Arduino which provide with the output alert.

The alert can be notified using buzzer alarm, on the monitor screen, and in the mobile phones using GSM module. Therefore, Medical Sector can have a secure and safe environment under VLC data transfer technology, which is a convenient source of transmission, bio-friendly and economical.

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