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Indoor navigation and positioning using LI-FI Technology

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Abstract:
The project aims at designing a wireless system that enables to find out the present location of a person and also voice enabled announcement system. This project also helps in authentication as well as automatic attendance registration. The technologies used in this project are LI-FI, an indoor localization system based on off-the-shelf Wi-Fi infrastructure and mobile phones. LI-FI is deployed in an office building covering over 1600m^2, and its deployment is easy and rapid since little human intervention is needed. In LI-FI, the calibration of fingerprints is crowd sourced and automatic. Experiment results show that LI-FI achieves comparable location accuracy to previous approaches even without site survey. The controlling device of the whole system is a Microcontroller this project aim is to identifying the different blocks in the organization. Here we are using three push buttons by using these buttons we can identify the three blocks in the organization. And we can know where is the exact location of the block in the organization .and this information goes to the receiver and we can observe the on LCD.and at the same time we can here the voice by using voice circuit. To perform the intelligent task, Microcontroller is loaded with intelligent program written using embedded 'C' language.

Keywords: PIC microcontroller; Li-fi module; voice Module; lcd display; led indicaters.

Introduction :

The project aims at designing a wireless system that enables to find out the present location of a person and also voice enabled announcement system. This project also helps in authentication as well as automatic attendance registration.

The technologies used in this project are LI-FI, an indoor localization system based on off-the-shelf Wi-Fi infrastructure and mobile phones. LI-FI is deployed in an office building covering over 1600m^2, and its deployment is easy and rapid since little human intervention is needed. In LI-FI, the calibration of fingerprints is crowd sourced and automatic. Experiment results show that LI-FI achieves comparable location accuracy to previous approaches even without site survey. The controlling device of the whole system is a Microcontroller this project aim is to identifying the different blocks in the organization. Here we are using three push buttons by using these buttons we can identify the three blocks in the organization. And we can know where is the exact location of the block in the organization .and this information goes to the receiver and we can observe the on LCD.and at the same time we can here the voice by using voice circuit. To perform the intelligent task.

Project Overview:

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers. Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result. **The project "**Indoor navigation and positioning using LI-FI Technology**"** using PIC16F72, PIC16F877A microcontroller is an exclusive project which is used to find the position identification for the different blocks in the organization by using the LI-FI. **.**

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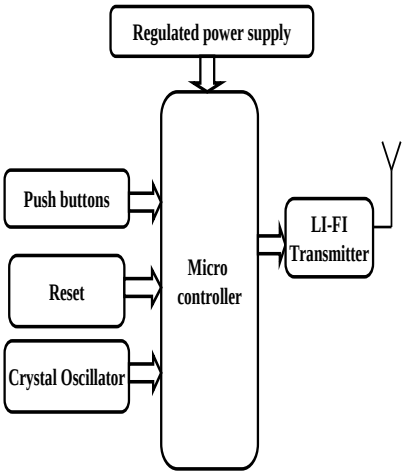
HARDWARE DESCRIPTION :

In this chapter the block diagram of the project and design aspect of independent modules are considered. Block diagram is shown in fig

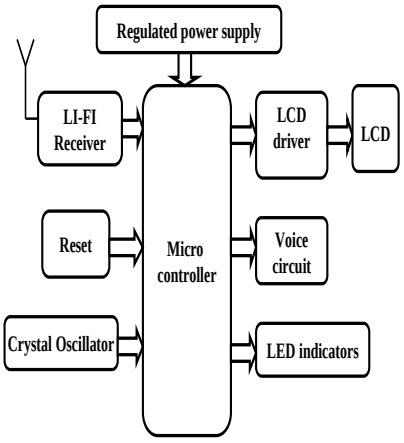
Transmitter section:

Indoor navigation and positioning using LI-FI Technology
2.Transmitter



Receiver section:

Indoor navigation and positioning using LI-FI Technology
2.Receiver



PIC Compiler:

PIC compiler is software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. PIC compiler also supports C language code.

It's important that you know C language for microcontroller which is commonly known as Embedded C. As we are going to use PIC Compiler, hence we also call it PIC C. The PCB, PCM, and PCH are separate compilers. PCB is for 12-bit opcodes, PCM is for 14-bitopcodes, and PCH is for 16-bit opcode PIC microcontrollers. Due to many similarities, all three compilers are covered in this reference manual. Features and limitations that apply to only specific microcontrollers are indicated within. These compilers are specifically designed to meet the unique needs of the PIC microcontroller. This allows developers to quickly design applications software in a more readable, high-level language. When compared to a more traditional C compiler, PCB, PCM, and PCH have some limitations. As an example of the limitations, function recursion is not allowed.

This is due to the fact that the PIC has no stack to push variables onto, and also because of the way the compilers optimize the code. The compilers can efficiently implement normal C constructs, input/output operations, and bit twiddling operations. All normal C data types are supported along with pointers to constant arrays, fixed point decimal, and arrays of bits.

PIC C is not much different from a normal C program. If you know assembly, writing a C program is not a crisis. In PIC, we will have a main function, in which all your application specific work will be defined. In case of embedded C, you do not have any operating system running in there. So you have to make sure that your program or main file should never exit. This can be done with the help of simple while (1) or for (;;) loop as they are going to run infinitely.We have to add header file for controller you are using, otherwise you will not be able to access registers related to peripherals.

Li-Fi :

Li-Fi is a subset of optical wireless communications (OWC) and can be a complement to RF communication (Wi-Fi or Cellular network),

or a replacement in contexts of data broadcasting. It is wireless and uses visible light communication or infra-red and near ultraviolet (instead of radio frequency waves), part of communications technology, which carries much more information, and has been proposed as a solution to the RF-bandwidth limitations. A complete solution includes an industry led standardization process.

It is an OWC system that uses light from light-emitting diodes (LEDs) as a medium to deliver networked, mobile, high-speed communication in a similar manner as WiFi. Li-Fi could lead to the Internet of Things, which is everything electronic being connected to the internet, with the LED lights on the electronics being used as Li-Fi internet access points.[4] The Li-Fi market is projected to have a compound annual growth rate of 82% from 2013 to 2018 and to be worth over $6 billion per year by 2018.

Visible light communications (VLC) works by switching bulbs on and off with in nanoseconds, which is too quickly to be noticed by the human eye. Although Li-Fi bulbs would have to be kept on to transmit data, the bulbs could be dimmed to the point that they were not visible to humans and yet still functional. The light waves cannot penetrate walls which makes a much shorter range, though more secure from hacking, relative to Wi-Fi. Direct line of sight isn't necessary for Li-Fi to transmit a signal; light reflected off the walls can achieve 70 Mbit/s.

Li-Fi has the advantage of being useful in electromagnetic sensitive areas such as in aircraft cabins, hospitals and nuclear power plants without causing electromagnetic interference Both Wi-Fi and Li-Fi transmit data over the electromagnetic spectrum, but whereas Wi-Fi utilizes radio waves, Li-Fi uses visible light. While the US Federal Communications Commission has warned of a potential spectrum crisis because Wi-Fi is close to full capacity, Li-Fi has almost no limitations on capacity. The visible light spectrum is 10,000 times larger than the entire frequency spectrum. Researchers have reached data rates of over 10 Gbit/s, which is more than 250 times faster than superfast broadband. Li-Fi is expected to be ten times cheaper than Wi-Fi. Short range, low reliability and high installation costs are the potential downsides.

Pure LiFi demonstrated the first commercially available Li-Fi system, the Li-1st, at the 2014 Mobile World Congress in Barcelona.

Compatibility with artificial lighting present in infrastructures, and the interference which may be generated by ambient lighting. The MAC layer permits using the link with the other layers as with the TCP/IP protocol

The standard defines three PHY layers with different rates:

- The PHY I was established for outdoor application and works from 11.67 kbit/s to 267.6 kbit/s.
- The PHY II layer permits reaching data rates from 1.25 Mbit/s to 96 Mbit/s.
- The PHY III is used for many emissions sources with a particular modulation method called color shift keying (CSK). PHY III can deliver rates from 12 Mbit/s to 96 Mbit/s.

The modulation formats recognized for PHY I and PHY II are on-off keying (OOK) and variable pulse position modulation (VPPM). The Manchester coding used for the PHY I and PHY II layers includes the clock inside the transmitted data by representing a logic 0 with an OOK symbol "01" and a logic 1 with an OOK symbol "10", all with a DC component. The DC component avoids light extinction in case of an extended run of logic 0's.

LiFi's early developmental models were capable of 150 megabits-per-second (Mbps). Some commercial kits enabling that speed have been released. In the lab, with stronger LEDs and different technology, researchers have enabled 10 gigabits-per-second (Gbps), which is faster than 802.11ad

Benefits of Li-Fi:

- Higher speeds than Wi-Fi.
- 10000 times the frequency spectrum of radio.
- More secure because data cannot be intercepted without a clear line of sight.
- Prevents piggybacking.
- Eliminates neighboring network interference.
- Unimpeded by radio interference.

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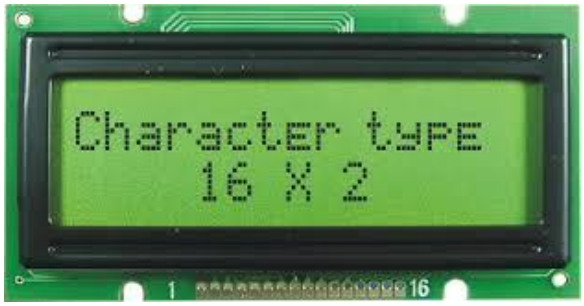
Voice circuit :

The APR9600 device offers true single-chip voice recording, on-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. Integrated output amplifier, microphone amplifier, and AGC circuits greatly simplify system design. the device is ideal for use in portable voice recorders, toys, and many other consumer and industrial applications. APLUS integrated achieves these high levels of storage capability by using its proprietary Analog/multilevel storage technology implemented in an advanced Flash non-volatile memory process, where each memory cell can store 256 voltage levels. APR9600 block diagram is included in order to describe the device's internal
architecture. At the left hand side of the diagram are the analog inputs. A differential microphone amplifier, including integrated AGC, is included on-chip for applications requiring use.The amplified microphone signals fed into the device by connecting the ANA_OUT pin to the ANA_IN pin through an external DC blocking capacitor. Recording can be fed directly into the ANA_IN pin through a DC blocking capacitor, however, the connection between ANA_IN and ANA_OUT is still required for playback. The encountered by the input signal is the internal anti-aliasing filter. The filter automatically adjust its response according to the sampling frequency selected so Shannon's Sampling Theorem is satisfied. After anti-aliasing filtering is accomplished the signal is ready to be clocked into the memory array. This storage is accomplished through a combination of the Sample and Hold circuit and the Analog Write/Read circuit. These circuits are clocked by either the Internal Oscillator or an external clock source. When playback is desired the previously stored recording is retrieved from memory, low pass filtered, and amplified as shown on the right hand side of the diagram. The signal can be heard by connecting a speaker to the SP+ and SP- pins. Chip-wide management is accomplished through the device control block shown in the upper right hand corner. Message management is provided through the message control block represented in the lower center of the block diagram. More detail on actual device application can be found in the Sample Application section. More detail on sampling control can be found in the Sample Rate and Voice Quality section. More detail on Message management and device control can be found in the Message Management section.

LCD Background:



One of the most common devices attached to a micro controller is an LCD display. Some of the most common LCD's connected to the many microcontrollers are 16x2 and 20x2 displays. This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

SYSTEM IMPLENTATION AND PERFORMANCE EVALUATION :

This project is implemented using following software's:

- Express PCB – for designing circuit
- PIC C compiler - for compilation part
- Proteus 7 (Embedded C) – for simulation part

4.3 Proteus:

Proteus is software which accepts only hex files. Once the machine code is converted into hex code, that hex code has to be dumped into the microcontroller and this is done by the Proteus. Proteus is a programmer which itself contains a microcontroller in it other than the one which is to be programmed. This microcontroller has a program in it written in such a way that it accepts the hex file from the pic compiler and dumps this

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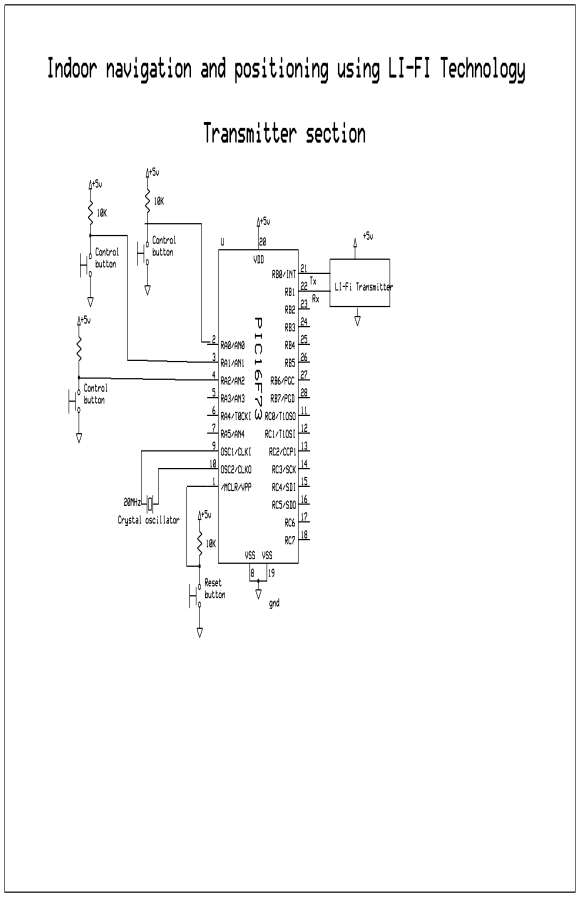
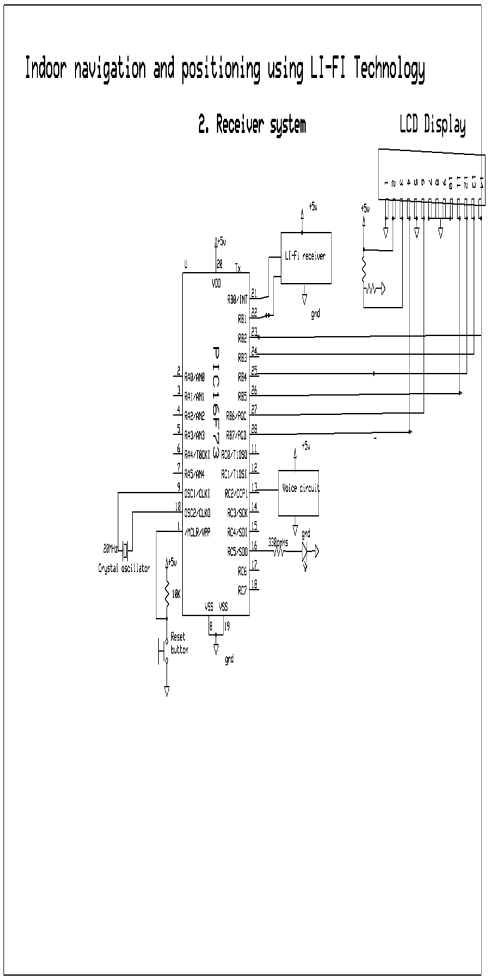
hex file into the microcontroller which is to be programmed. As the Proteus programmer requires power supply to be operated, this power supply is given from the power supply circuit designed and connected to the microcontroller in proteus. The program which is to be dumped in to the microcontroller is edited in proteus and is compiled and executed to

check any errors and hence after the successful compilation of the program the program is dumped in to the microcontroller using a dumper.





Result:

The project "**Indoor navigation and positioning using LI-FI Technology**" was designed such that to identifying the different blocks in the organization by using Li-FI module. The locations are displayed on LCD when the person reaches those particular locations.

7.2 Conclusion:

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

Future Scope:

Our project ""**Indoor navigation and positioning using LI-FI Technology**" is mainly intended to alert the person through location names displayed on LCD when he enters into a particular location by using LI-FI module . This system consists of a LI-FI receiver, the location names are displayed on LCD. The micro controller is programmed in such a way that depending on the satellite information of location the predefined location name will be announced and also displays on the LCD. This project can be extended using a GSM module. The GSM module gives the intimation of the person with this system through SMS.

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