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Wireless Notice Board using UWB with Monitoring System

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Abstract: Notice Board is a primary thing in any institution / organization or public utility places like bus stations, railway stations and parks. But sticking various notices day-to-day is a difficult process. This project deals with an advanced wireless notice board. This project is designed using ARM-LPC2148 interfaced with Graphical Display. At present, when information has to be updated in a notice board, it has to be done manually. Also in present electronic systems, no matter how many displays are present, only a single notice can be sent to all of the notice boards irrespective of their places. In order to overcome this disadvantage, multiple displays along with a decoder are used to select a particular display and the corresponding information is sent through an ARM controller by using UWB technology. The entries can be documented and a record may be maintained for future use by using visual basic. The controller has internal a real time clock used for synchronization of data. A resistive touch screen is used to access the previous notices and also progress details. The monitoring system consists of an image sensor which captures the images for the specified amount of time and the images can be transferred through an USB port to a PC for storage purposes.

Keywords: LPC2148, UWB, E-notice board, monitoring system.

I. Introduction

This is an embedded based project. An embedded system is a combination of hardware and software and perhaps other mechanical parts designed to perform a specific function. A Notice Board is a very essential device in any institution / organization or public utility place like bus stations, railway stations and parks. The main aim of this project is to design an automatic display which reduces the manual operation. The information can in turn be updated instantly at the desired location. Updates can be done in individual displays without disturbing other displays. The message to be displayed is sent as an SMS to a GSM receiver module. This message is then stored in PC and is sent to the LCD displays through the controller. The messages stored in the computer acts as a record for future reference.

The monitoring system includes a micro-miniature camera which would be capable of acquiring 3 mega pixel color images, transfer them on to a personal computer through a Universal Serial Bus (USB) link, and also store the image in a micro SD card after applying an image compression algorithm. The report explains how a raw image data is captured by a CCD sensor and interfacing of the sensor with an ARM7 processor.

II. Component Description

A. LPC2148 ARM CONTROLLER

We are using LPC2148 which is an Advanced RISC Machine. It is a 32 bit controller which follows Von Neumann architecture. It has a 3 way pipelining and a memory of 4GB along with two UARTs. Many external peripherals can also be interfaced with ARM if required, such as CAN controller interfacing.

We preferred ARM over PIC because of its faster response i.e. it operates at a speed of 60 MHz and also due to its interrupt priority feature. It consumes less power and is used in applications were miniaturization is of paramount importance. Since we are using both the UARTs it is necessary to prioritize the event occurring in the controller. A real-time clock which operates at 32

KHz is in-built in the controller.

B. LCD

A 16x2 character LCD with black text on green background display is used. Being sufficiently wide it serves the purpose of a notice board display screen. It operates at 5V DC with a duty cycle of 1/16. Multiple LCD displays are used among which any one display can be chosen for displaying the notice. We use a maximum of three LCDs in this project.

C. GRAPHICAL LCD

Besides writing text, this serial graphic LCD allows the user to draw lines, circles and boxes, set or reset individual pixels, erase specific blocks of the display, control the backlight and adjust the baud rate. 128x64

LCD is divided equally into two halves. Each half is controlled by a separate controller present within itself.

D. UWB MODULE

Existing ultra-wideband (UWB) techniques rely on symmetric transmitter and receiver structures, which assume the same complexity level at all nodes throughout the network. In single-band (SB) UWB, this assumption implies high-rate digital-to-analog (DA) and analog-to-digital (AD) converters at all nodes. In a multi-band (MB) UWB, this assumption means (multiple) local oscillators and frequency synthesizers at all devices, which are very power consuming and prone to carrier frequency and phase offsets. However, to establish physical communication links between nodes with distinct complexity requirements, asymmetric UWB transceivers need to be designed. This motivates our transceiver designs for the asymmetric UWB links which allow the weak nodes to retain low-complexity at both the Tx and Rx modes, and vice versa.

In asymmetric UWB links, both high-complexity nodes and low-complexity nodes can exist at the transmit end or the receive end. The low-complexity node (LCN) only realizes the simplest single-band transmission with low A/D and D/A conversion rates. The high-complexity node (HCN) can be a SB-UWB transceiver with high A/D and D/A conversion rates or a multi-band (MB) UWB one with multiple local oscillators. We carefully design transceivers that account for different operating rates at individual nodes and ensure seamless network operation. We have proved that the (single-antenna) asymmetric link model can be converted to a multi-input multi-output (MIMO) system model with multiple Tx and Rx antennas.

Once the conversion is achieved, the transceiver designs for multi-antenna communications can be readily adopted. This is particularly attractive for UWB communications where complexity is a major concern. Especially, we deploy the geometric mean decomposition (GMD) approach to achieve optimality in terms of both channel throughput and bit error rate (BER). Our analyses, together with the simulations, confirm the feasibility and effectiveness of our asymmetric UWB links with MIMO techniques.

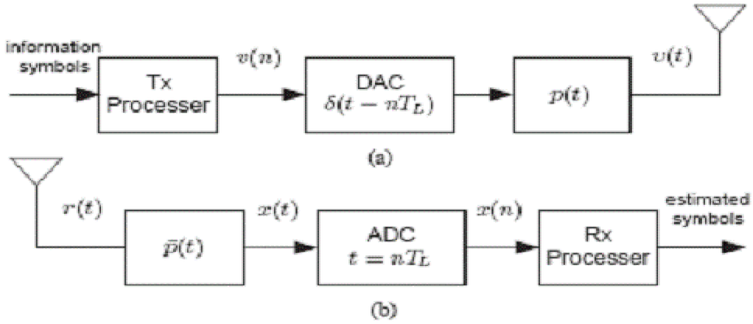

Fig: Low-complexity Node Transmitter and Receiver diagram

E. AUDIO DRIVER

The ohm is the unit of measure for impedance, which is the property of a speaker that restricts the flow of electrical current through it. Typical speakers have impedance ratings of 4 ohms, 8 ohms or 16 ohms. The ohms rating of the speaker indicates how much energy it takes to drive it - the higher the ohms rating, the more difficult it is to drive. In our project we have used 8 ohms speaker to alert whenever an event takes place.

F. VB TOOL

Visual Basic (VB) is a programming environment and language, which based the language on an existing version for beginning programmers, BASIC. Prior to VB, programmers wrote programs in the C or C++ programming language, which had no built-in support for accessing Windows functions. VB does have such support as part of its object-oriented programming approach. In our project we use VB for storing large amount of information. The controller gets the required information from the computer using VB. The information will be in any one of the following form such as images, students mark and the messages received.

G. TOUCH PANEL

Touch-screens are typically found on larger displays, in phones with integrated PDA features. Most are designed to work with either your finger or a special stylus. Tapping a specific point on the display will activate the virtual button or feature displayed at that location on the display. We have used a resistive touch screen along with the graphical LCD. Thus the touch panel is used to scroll back and forth between the messages. The previous messages are stored in the computer for future reference.

III. MODULES

A. Module 1

In this module the controller is interfaced with displaying unit. The displaying unit consists of LCD and a graphical LCD. The message for this unit comes from an authorized receiver using UWB technology.

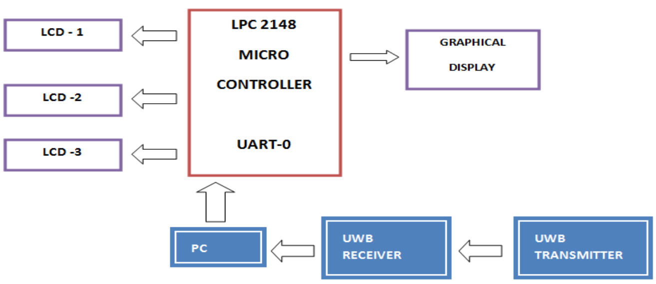

Fig: Block diagram

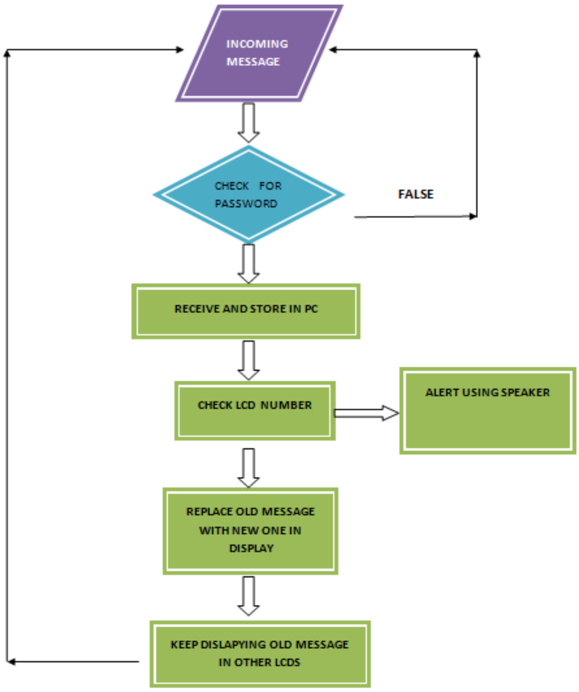

Fig: Flowchart

B. Module 2

This module consists of a speaker and a real time clock. The speaker is used to announce the event of arrival of new information. An interrupt is generated every time a message is received and a pre-recorded message is announced by the speaker. A real time clock runs within the system which records the timing detail of the messages received.

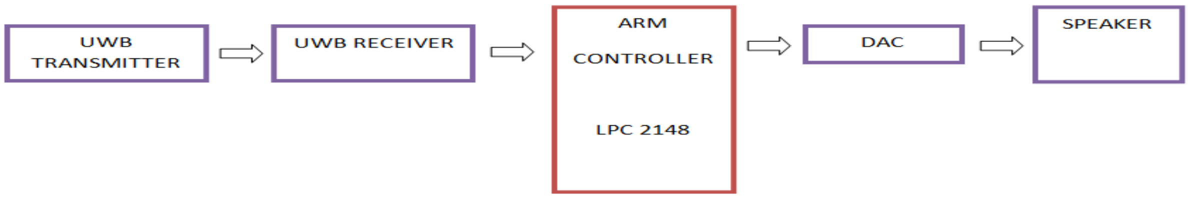

Fig: Block diagram for announcing

IV. OPERATION

Initially an authorized mobile user will send a message containing information to choose the required LCD display. For security purpose we have included a password. Access will be granted to the user who is aware of the password. Once the message is received it is stored in the computer. Here a real time clock displays the time in the graphical LCD. The graphical display can be used to view the marks of the students or any information about the institution or organization. When there is a high priority message (mobile user) the current information that is displayed will be held up and this high priority message will be displayed. The audio driver which has the pre-recorded voice will announce the arrival of new messages.

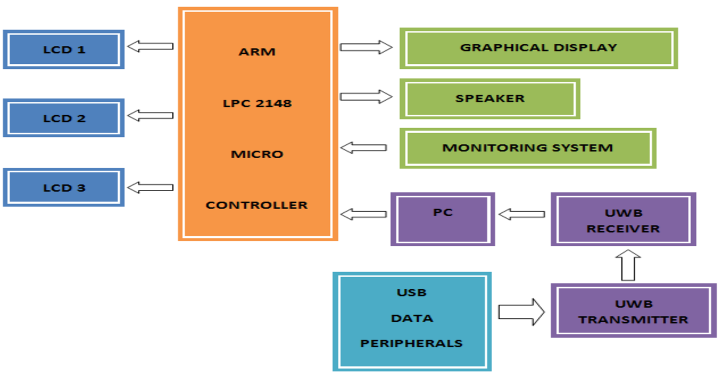

Fig: Block diagram of SMS based wireless notice board

V. ADVANTAGE OF USING UWB

ADVANTAGES

LARGE CHANNEL CAPACITY

One of the major advantages of the large bandwidth for UWB pulses is improved channel capacity. *Channel capacity*, or data rate, is defined as the maximum amount of data that can be transmitted per second over a communications channel. The large channel capacity of UWB communications systems is evident from Hartley-Shannon's capacity formula:

$$C = B\log_2(1+SNR)$$

Where *C* represents the maximum channel capacity, *B* is the bandwidth, and SNR is the signal-to-noise power ratio. As shown in Equation 1-5, channel capacity *C* linearly increases with bandwidth *B*. Therefore, having several gigahertz of bandwidth available for UWB signals, a data rate of gigabits per second (Gbps) can be expected. However, due to the FCC's current power limitation on UWB transmissions, such a high data rate is available only for short ranges, up to 10 meters. This makes UWB systems perfect candidates for short-range, high-data-rate wireless applications such as wireless personal area networks (WPANs). The trade-off between the range and the data rate makes UWB technology ideal for a wide array of applications in military, civil, and commercial sectors.

ABILITY TO WORK WITH LOW SIGNAL-TO-NOISE RATIOS

The Hartley-Shannon formula for maximum capacity (Equation 1-5) also indicates that the channel capacity is only logarithmically dependent on signal-to-noise ratio (SNR). Therefore, UWB communications systems are capable of working in harsh communication channels with low SNRs and still offer a large channel capacity as a result of their large bandwidth.

RESISTANCE TO JAMMING

Unlike the well-defined narrowband frequency spectrum, the UWB spectrum covers a vast range of frequencies from near DC to several gigahertz and offers high processing gain for UWB signals. Processing gain (PG) is a measure of a radio system's resistance to jamming and is defined as the ratio of the RF bandwidth to the information bandwidth of a signal:

$$PG = \frac{RF\ band\ width}{Information\ band\ width}$$

The frequency diversity caused by high processing gain makes UWB signals relatively resistant to intentional and unintentional jamming, because no jammer can jam every frequency in the UWB spectrum at once. Therefore, if some of the frequencies are jammed, there is still a large range of frequencies that remains untouched. However, this resistance to jamming is only in comparison to narrowband and wideband systems. Hence, the performance of a UWB communications system can still be degraded, depending on its modulation scheme, by strong narrowband interference from traditional radio transmitters coexisting in the UWB receiver's frequency band

VI. CONCLUSION

The code was written in Keil and then was simulated using Proteus simulator. The results were satisfactory we went about with the hardware implementation part. The message from data peripherals was successfully transmitted through USB UWB transmitter. The data received at UWB receiver was accurate and sent for further effective processing. The hardware part was also implemented using a decoder board for the choosing among the multiple LCDs and the speaker part was also implemented successfully. But in order to use ARM controller in full effectiveness, much more development can be brought about such as the addition of a monitoring system which can make use of the other UART.

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Dr Himani is a Senior Member of IEEE and Member of IEEE Nanotechnology Council and IEEE Sensors Council. She is Vice Editor in Chief of Blue Eyes Intelligence International Journal, also an Editorial Board member of IJARSET. She has completed her Ph.D. degree from Center for Energy Studies, Indian Institute of Technology, Delhi. She did her BE in Electronics Engineering from R.A.I.T., University Of Mumbai, Mumbai, India in 1995 and M.Tech. in Alternate Hydro Energy Systems from, IIT Roorkee in 2000-2001.She has also done her Masters in Business Administration with specialization in International Marketing from University of Pune. She is working in the area of Automatic Control of Small hydro power plants and has published and presented number of papers in international conferences. Dr Himani has more than 20 years of experience in teaching, research and development. She is at present working as Dean of Electronics and Communication Engineering department at MLR Institute of Technology, Dundigal, Hyderabad- 5000 43.

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