DESIGN OF SMART BOARDS WITH PORTABLE TOUCH SCREEN AND WIRELESS PROJECTION USING EMBEDDED SYSTEM

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Abstract— Multimedia applications is a very common trend nowadays in classroom teaching. Traditional chalk board system produces a lot of chalk dust which pollutes the air and also affects adversely on the health of students and teachers. Whereas, on the other hand using multimedia in teaching process helps in better learning and understanding. Different international firms like Panasonic, Hitachi are working on developing the technology which can efficiently replace the traditional blackboard. In this project a combined solution for blackboard and classroom monitoring is studied, This design includes two modules, viz, ARM7 board processor for user controlled unit that can be handheld terminal with embedded linux operating system for its software. And the other unit consists of Raspberry-Pi ARM11 board. This is remote unit which is to be connected to the projector through HDMI port. When a person writes on touch screen of the hand held unit using a stylus, the signals are converted into electrical signals and are transmitted wirelessly to the ARM11 board. Wireless transmission is using RF module (Zigbee). ARM11 board processes the signal and displays the written content using projector, Also the Raspberry Pi module can be connected to WiFi network, so that the classroom teaching can be monitored from a distant location, say, Principals office/cabin. Thus, quality of teaching can also be monitored. Further advancements of the system includes attendance monitoring and video monitoring Thus, the complete system is a part of smart classroom resulting in easy and efficient teaching and learning procedures.

Index Terms— ARM7, Raspberry Pi, Touch screen, Wireless, Zigbee .

I. INTRODUCTION

In India, the traditional scheme of teaching using blackboards, has many disadvantages such as teacher has to approach the blackboard if he wants to explain his point. Traditional teaching scheme still uses chalk-blackboard or slate pencil approach. If it is possible for him to write or draw on the board remotely i.e. without actually approaching the board, it will be convenient for him as well as students. Through this project we are trying to draw a pattern or figure what we write on touch pad on transmitter side with the help of Touchscreen equipped portable device. The chalk, which is simply compressed dust, can bother some educators and students with allergies, not to mention land on top of other school equipment that is dust sensitive, such as computers and microscopes.

The idea of cost reduction and enhancing the quality of service in the field of technology-aided teaching is put forth in this

paper . It proposes the use of ARM and Raspberry Pi for wireless transmission and reception of hand written signals to be displayed on the projector. Also web interface of Raspberry Pi is used to store files that have been sent from remote sources and view these power point files or Portable Document Files (PDF) on the projector. The aim of the proposed system is to substitute laptops with Raspberry Pi which will drastically reduce the cost involved. Also the system will consume a smaller amount of power, yet will provide the same functionality as any other similar system does System Design.

II. SYSTEM OVERVIEW

System includes two units which are handheld unit and remote unit. Handheld unit receives processes and sends handwritten signals to the remote unit by using RF module (Zigbee). Handheld unit includes ARM7 board, Touch screen, GLCD display and Zigbee module interfaced using MAX232 IC. Remote module is a Raspberry Pi ARM11 board which has HDMI port to display processed handwritten signals in larger view by interfacing projector with it.

A. Handheld transmitter unit

At the handheld unit terminal we are using ARM7 board with GLCD and touch screen. The touch sensed by the touch screen is converted into electrical signal by the processor and transmitted to the remote unit wirelessly via zigbee. Also at this unit, inputs are provided for power supply.

B. Remote receiver unit

At the receiver side we are using Raspberry-Pi ARM11 board for processing of the signals that are sent from the handheld unit. In last article we saw that these signals are again received using Zigbee receiver. For interfacing Zigbee module we are using MAX232 IC. ARM 11 boards gives output signals at the HDMI port which can be visualized on the projector display. Raspberry-Pi Arm11 also has USB port to play or run the files stored in the external USB device such as pen-drive.

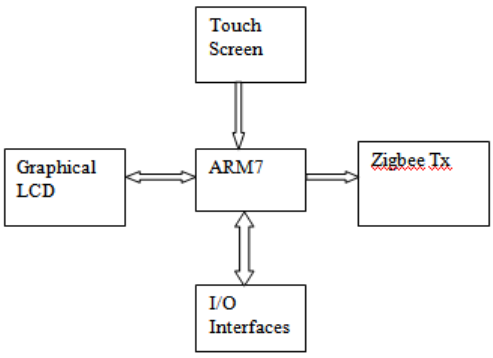


Fig1. Block Diagram of the handheld transmitter unit

At the handheld unit terminal we are using ARM7 board with GLCD and touch screen. The touch sensed by the touch screen is converted into electrical signal by the processor and transmitted to the remote unit wirelessly via zigbee.

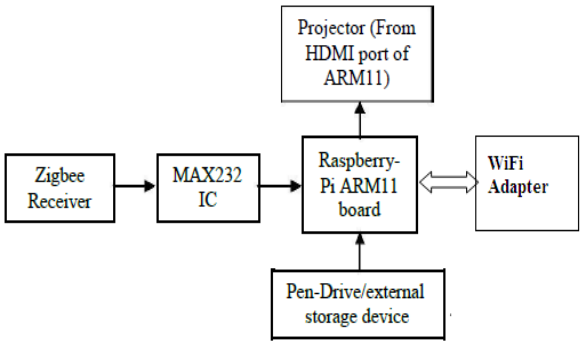


Fig2. Block Diagram of the remote reciever unit

III. HARDWARE DESIGN

Handheld Unit Hardware Design:

Handheld unit includes ARM7 Advanced RISC Machine. ARM boards have power saving features due to which they are widely used in mobile electronic devices where low power consumption is critical consumption goal.

Touch screen display is used to receive handwritten signals

and RF module interface for sending signal to remote module using Zigbee transmitter. Diagrammatic structure of handheld terminal unit is shown in figure 1.

A. ARM7

Arm7 board includes LPC2138 IC which is 32 bit advanced RISC machine. Conversion speed of ARM7 is faster than that of 8051 microcontroller. It has multiple serial interfaces

including two UARTs (16C550), two fast I2C bus (400Kbps), SPI and SSP with buffering and variable data length capabilities, two inbuilt ADC, a DAC, a RTC, etc. For operation of ARM7, Keil µV 4 is used which runs on a platform of embedded C programming. Orcad 9.1 is used for circuit designing. All interfacings including Zigbee, resistive touch screen, graphical LCD are simulated; PCB is tested in Protel 99SE software. ARM boards have power saving features due to which they are widely used in mobile electronic devices where low power consumption is critical consumption goal. Role of ARM7 is to collect, analyze and process the signals obtained from touch screen.

B. Touch Screen

A touch screen is an electronic display which is sense the location of a touch within the display region. In this project the 4 wire resistive touch screen display is used. The phrase generally refers to touching the display of the device with a finger and stylus. Fig. shows how to interface the touch panel with the LPC2138 processor. To identify the touched location, we have to read touch position consecutively i.e. first read X position and then read the Y position.

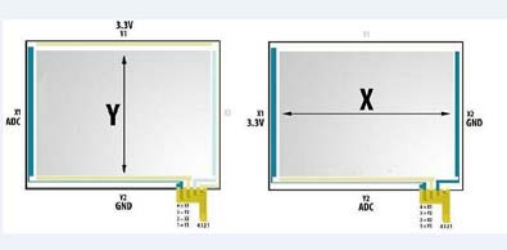


Fig3(a). Touch Screen Foils

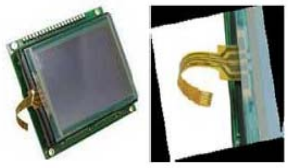


Fig3(b). Touch screen display

a. Principle of operation

The resistive touch panel is constructed by sandwiching two transparent rigid foils having resistive layer on their inner side. Usually the resistance of the foil should not exceed 1Kohm. Contacts made on the opposite sides of the foils by a flat cable. The process of identifying the touched place point is partitioned into two steps. The first step is to identify the X co-ordinate and the second one is to identify the Y co-ordinate. For determining the X co-ordinate, left contact on the X surface is connected to ground i.e. 0 voltage levels and the right contact is connected to the power supply. Thus voltage divider is made when we touches on the screen. Y surface bottom contact reads the values of divider. The divider voltage ranges from 0V to power supply voltage and it depends upon the X coordinate.

Table1. Touch screen Configuration

Touchscreen Configuration				
	X1	X2	Y1	Y2
To Measure X position	Logic High (+5v or +3.3v)	Logic Low(GND)	--	ADC
To Measure Y position	ADC	--	Logic Low(GND)	Logic High(+5v or +3.3v)

If the touch is nearer to X surface left contact, then the voltage is taken as 0V by the processor. In order to identify Y co-ordinate of Y surface then bottom contact of surface Y is grounded and upper contact is connected to power supply.

C. Graphical Liquid Crystal Display (GLCD)

In this paper, 128x64 Liquid crystal displays are used for the design as the 16x2 Character LCDs have their own restrictions; they can only display characters of certain magnitudes. While 128x64 liquid crystal display that support Chinese character, English characters and even graphics, very suitable for interactive work with ARM7Thus the Graphical LCD is used to display modified characters and images. The Graphical LCD is use in various applications like in video games, mobile phones, and lifts etc. as display units. Various graphical LCDs are available in the market with different sizes.

These LCDs have a graphics and a text mode, so we decided to use it in graphics mode and draw the text manually. This would only be practical on an ARM (or companionable) as we should need 1KB (128x64/8 = 1024 bytes) of memory for a screen buffer, plus memory for the characters. The operation of the display was first implemented by turning it on by sending the instruction to the screen as shown in Table 1.

Table 2. Display Instruction of GLCD

Instruction	D/I	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Display	0	0	0	0	1	1	1	1	1	1

To draw any data on the screen, there are entire of 8192 pixels on a 128 X 64 pixel screen and every pixel is control by a sequence of instructions. The screen is split into its X and Y axis. The Y axis represents the line to which pixel should be written to and the X axis shows the column to which they will be written to. The following stage is issuing a data write command, data bits which are high will be darkened on the Y address line in the X page. The driver scans over the pages, using the core Y address counter to its advantage and resetting the X page as it scans through the lines .

D.Zigbee transreceiver

A WSN consists of many inexpensive wireless sensors, which are capable of collecting, storing, processing environmental information, and Communicating with neighbouring nodes. ZigBee/IEEE 802.15.4 is a global hardware and software Standard designed for WSN requiring high reliability, low cost, low power, scalability, And low data rate .

The Zigbee is the wireless sensor. It is use for the wireless communication between two nodes. The fig 6 shows the zigbee wireless Trans-receiver sensor. In this present project the encoded drawn text pattern or images are transmitted towards the receiver side by using zigbee transmitter. The same type of zigbee wireless sensor is used at receiver side for receiving purpose. ZigBee and IEEE 802.15.4 are designed for lightweight sensor platforms. ZigBee is designed to support low-cost network layer. In ZigBee, the network layer provides reliable and secure transmissions among devices.

E. Raspberry Pi

Raspberry Pi is a credit card sized computer. It's basically a small PC which provides all the basic functions that are provided by a desktop PC. For example, it provides functions like word processing, gaming and playing audio/video. It has become a widely used device for learning programming since last one year.

The Raspberry Pi is a 3.370 X 2.125 motherboard with a 700 MHz CPU and a 250 MHz GPU. The Ethernet LAN port is present for internet and remote access. It also has an HDMI port, through which it can be connected to any display device, like the monitor or the projector. Another great facility which Raspberry Pi provides is the presence of two USB ports, where one can connect his pen drive or USB mouse/Keyboard. General Purpose Input/output (GPIO) are a set of generic pins on a Raspberry Pi whose behavior can be controlled as well as programmed through software. The Raspberry Pi also has an SD card slot, which can act as an internal storage and can also store an image of Operating System.

IV. SOFTWARE DESIGN

A. Handheld Unit Software Design

Operations that are to be performed by handheld terminal unit are information collection from resistive touch screen, processing that information and sending signals to the remote terminal unit using wireless RF module. Inbuilt touch screen controller receives handwritten signals from the patterns drawn on touch screen with an interrupt signal to the LPC2138. Now, ARM7 reads this information, processes it and extracts the information contents in the signal. Information contained in the handwritten signal is extracted in relative registers by inquiring Interrupt Request Number (INR). This is called interrupt mode of LPC2138. This extracted information is stored in a queue called global touch message queue. One by one each touch message is received and processes by the processor.

After initialization of the handheld terminal unit hardware, when a pattern was drawn on the screen, the first dot is detected and its co-ordinates are calculated as explained in the explanation of resistive touch screen. As we draw a continue pattern, it is considered as string of dots. All such a dots are collected i.e. a free hand sketch or letter on graphical LCD is drawn that is drawn using the resistive touch screen. This string is then matched. If string matches then data is sent to the remote unit. If string does not match then again operation is repeated and touch screen message is read again. As long as touch message queue is nonempty, processing program starts processing the information and accordingly it launches the information for wireless sending.

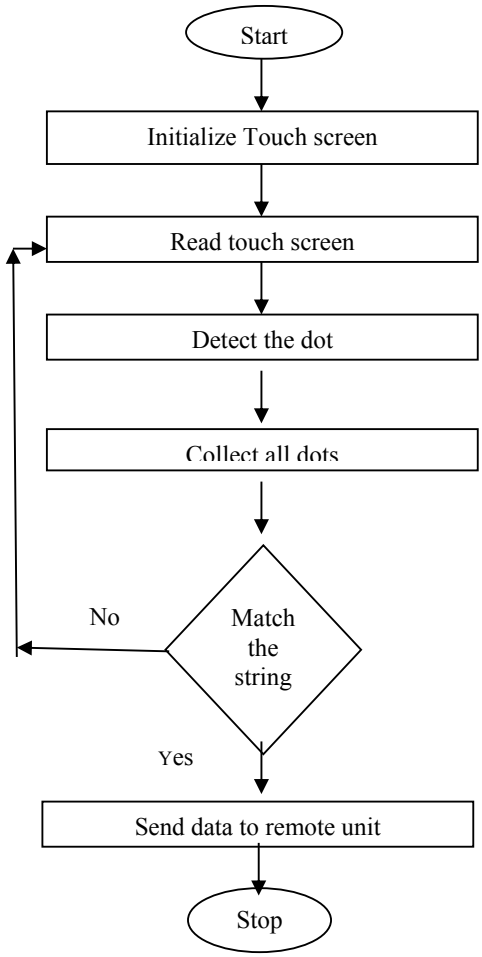
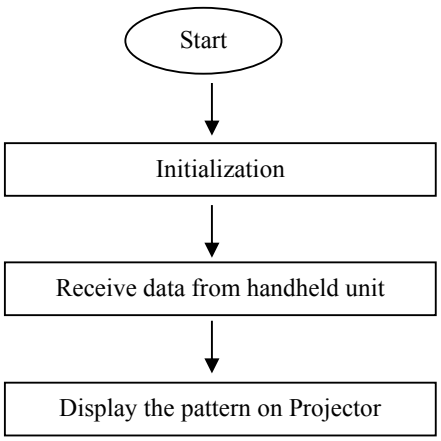


Fig.4 Flow chart for operation of touch (handheld)unit

B. Remote Unit Software Design

Remote unit mainly includes Raspberry-Pi ARM11 board. It receives signals from wireless receiver module in the receiving queue. If the receiving message queue is non-empty then terminal handler reads the information and displays in on the projector using video out interface after analyzing the read information.



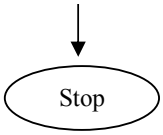


Fig.5 Flow chart for operation of remote unit

If the receiving message queue is non-empty then whole operation is again initialized. Flow chart for operation of remote unit is shown in fig 5.

Tasks of information collection, information extraction and displaying information are carried out under the Linux operating system along with embedded C programming for Raspberry Pi module.

V. FUTURE SCOPE

1. The project can be made more efficient by using a capacitive touch pad/touch screen.
2. In this project we can add the feature of letter recognition.
3. By using a proper method like finger print recognition method in the handheld terminal, we can implement the attendance monitoring in the same system.
4. Can provide memory element for showing the different file formats.
5. The proposed system can be efficiently used for the organizations where teacher can teach far distance class from the remote place by adding video calling to the proposed system.
6. Another future prospect is that we can project the text on projector in the standard fonts (Times New Roman, Calibri etc.) using Look up Table Functions in ARM. This can make system more user friendly to teachers and students.
7. By interfacing an appropriate memory to the proposed module, we can store the written text and resume it when we want to memorize it.
8. Overall objective of this project is to use Raspberry Pi and its web interface for storing files that have been sent from remote sources and view these files on the projector. Once Raspberry Pi has been set up and is ready to be used like a normal computer, applications can be installed thereby enabling to view all the Portable Document Files (PDF) and power-point presentations.
9. The next is to use a remote control to control

these applications. Controlling of Raspberry Pi can be achieved using a smart phone which almost everyone carries today. Some readily available applications on the Google Play Store include NetIO and XBMC server allowing creation of customized remote control to control Raspberry Pi.

VI. CONCLUSION

In this paper we successfully implemented the system which will allow the person to write on the board from a distance (50 meters). We also overcame the shortcomings of traditional chalk-blackboard approach of teaching by replacing it with easy to use portable touchscreen device. This system can be effectively implemented in schools and colleges as well. This design of hand held equipment is build using ARM7 processor which can interface to wireless module and touch screen. The data written on the screen is transferred to PC through wireless medium (Wi-Fi).This hand-held equipment is cost effective compared to present interactive white boards and is portable with many features similar to the computer/laptop.

VII. ACKNOWLWDGEMENT

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