Asian Journal of Convergence in Technology
Volume1, Issue 1

Design of Wireless Electric Board for Writing and Sketching Using ARM Based Embedded System

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***Abstract*— Multimedia applications are widely used for classroom teaching in current days. In traditional way of classroom teaching teacher have to write on a black board using dust producing chalks. But this is the conventional way that has been replaced by white boards. Chalks can produce lot of dust which causes hazardous effects on the health of students and teachers. These problems are overcome by using multimedia in classroom teaching. This helps in efficient teaching and learning process. With the advancements in technology, traditional black boards are replaced by smart equipments manufactured by companies like Hitachi, Panasonic etc. The proposed paper presents a wireless board which includes two modules viz. handheld terminal module and remote terminal module. Handheld module is controlled by user or teacher. Another module is remote module which consist of Raspberry Pi board (Broadcom BCM2835 700MHz ARM1176JZFS). It is also called as Rpi or RasPi. Teacher has to write on a resistive touch screen which is interfaced with ARM 7 board. Hand written signals are converted into electrical form & sent to ARM 11 Board by using wireless module (Zigbee). Remote unit collects, processes these signals & displays it in larger form on the screen using projector which can be interfaced with Raspberry Pi module using video out pin. This makes teaching and learning process more easy and efficient for the sake of students and teachers.**

Keywords— ARM 9, Arm11, Linux, Zigbee, HDMI

I. INTRODUCTION

Nowadays in some educational institutes, teachers are still writing on black boards using dusty chalks though it cannot fulfill the needs of efficient and advance teaching process. The boards manufactured by companies Hitachi and Panasonic costs very high which. Design which are previously invented costs a lot are not affordable in large quantity use. Proposed design presents a low cost design with added features and user friendly operation.

ARM7 is the heart of handheld terminal unit hardware which uses platform of embedded C programming in Keil version4 software. A resistive touch screen is used to receive handwritten signals from touch message information. These signals are converted in electrical signals which are then processes by ARM7 and transmitted by using wireless Zigbee module. There is a wireless Zigbee receiver at the remote terminal unit which receives the transmitted signals. These signals are then collected analyzed and processes by raspberry Pi. These are then displayed on screen with the help of projector which is connected to the video out pin or HDMI port of the Raspberry Pi. Zigbee is a freeware and it has support to device drivers of the different operating systems.

II. SYSTEM OVERVIEW

Proposed system consists of handheld terminal unit and remote terminal unit. Job of handheld unit terminal unit is to receive the handwritten signals, Zgbeee transmitter. Handheld unit includes ARM7 (LPC2138) IC board, a resistive touch screen, a graphical LCD, Zigbee transmitter module interfaced with board using MAX232 interface IC. Another module in system is remote terminal unit which consist of Raspberry Pi board (Broadcom BCM2835 700MHz ARM1176JZFS) board which has two USB ports, one video out pin for connection of projector, monitor or television receiver, a LAN connection slot, a micro USB slot for the supply, an audio jack, SD card slot, a HDMI port. Zigbee receiver receives the transmitted signals from handheld terminal unit.

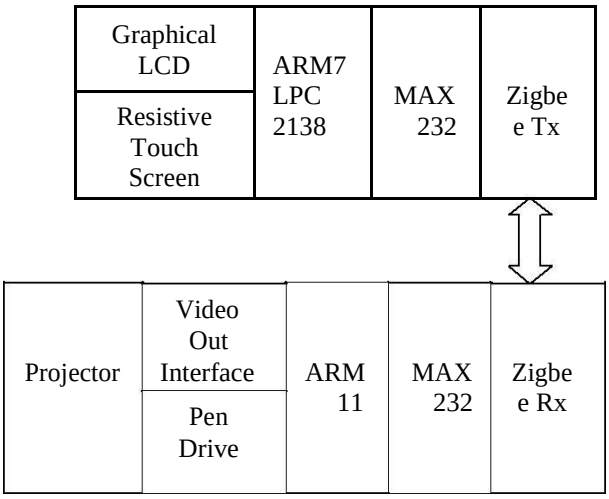


Fig. 1 Structural overview of system

Published on August 2014

These are then displayed on screen using projector, monitor or a television by interfacing any of them at the video out pin of Raspberry Pi.

Functional units included in Overall system are as shown in fig 1.

III. Design and Methods

3.1 Handheld Unit Hardware Design

Handheld unit includes ARM7 Advanced RISC Machine. In many applications where low power consumption is critical design goal, ARM are widely used as they have power saving features. A resistive touch screen is used to receive handwritten signals from user. It simply acts as a transducer which has resistive layers in horizontal (X) and vertical (Y) direction. When there is a touch on touch screen, according to the position of the touch there is a change in X channel resistance and Y channel resistance. Position of touch point is determined from X channel and Y channel resistance in terms of X and Y co-ordinates. These co-ordinates are interpreted into electrical form and processed by ARM7. Zigbee transmitter sends these signals to remote module within ISM band (2.4 GHz).

A. ARM7 (LPC2138)

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.[2]

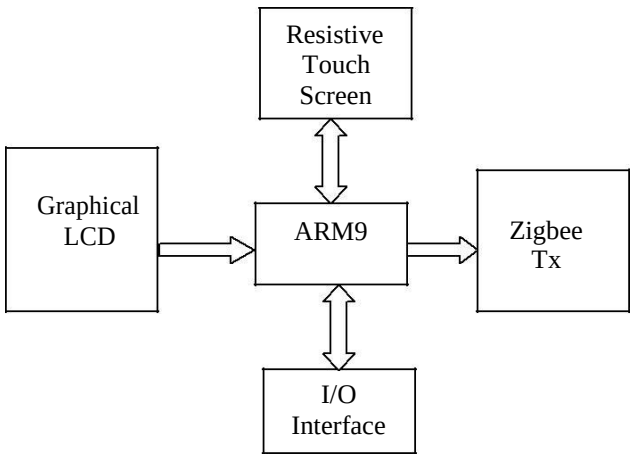


Fig. 2 Structure diagram of handheld terminal

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. RF Module (Zigbee)

Zigbee is a low cost, low power wireless mesh networking module which is standardized by IEEE 802.15. Zigbee module is intended to transmit information over a long communication distance by passing information through number of intermediate devices to reach more communication distance creating a mesh network. Zigbee allows larger battery life with small batteries due to its low power usage where as more extensive range and reliability of transmission is obtained due to its mesh configuration. Zigbee operates in Industrial Scientific and medical frequency band (2.4 GHz). This can provide simpler and less expensive technology than other wireless personal area networks (WPAN). In proposed system, role of Zigbee module is to transmit the handwritten signals from handheld terminal unit using a transmitter and also to receive them at the remote terminal unit using Zigbee receiver in frequency band of 2.4 GHz.[3]

3.2) 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.

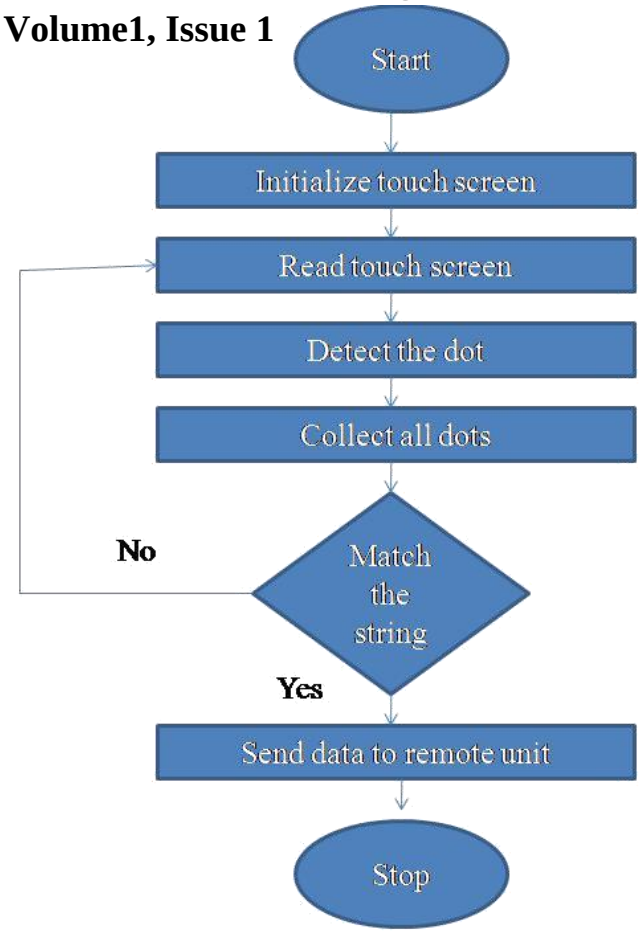


Fig 3. Flow of software for handheld terminal unit

As long as touch message queue is nonempty, processing program starts processing the information and accordingly it launches the information for wireless sending.

3.3) Remote Unit Hardware Design

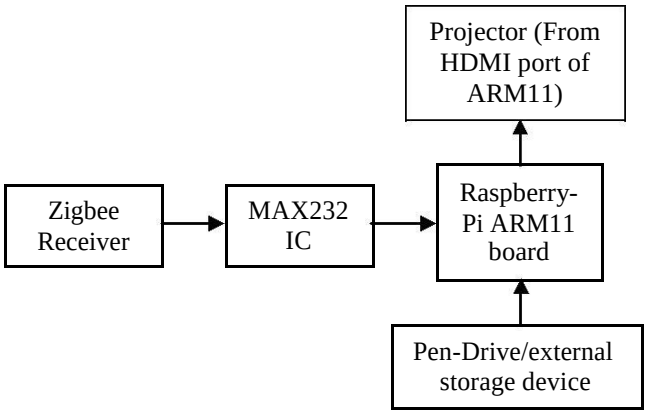


Fig. 4. Hardware for Remote Unit

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.[15]

3.4) 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.

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

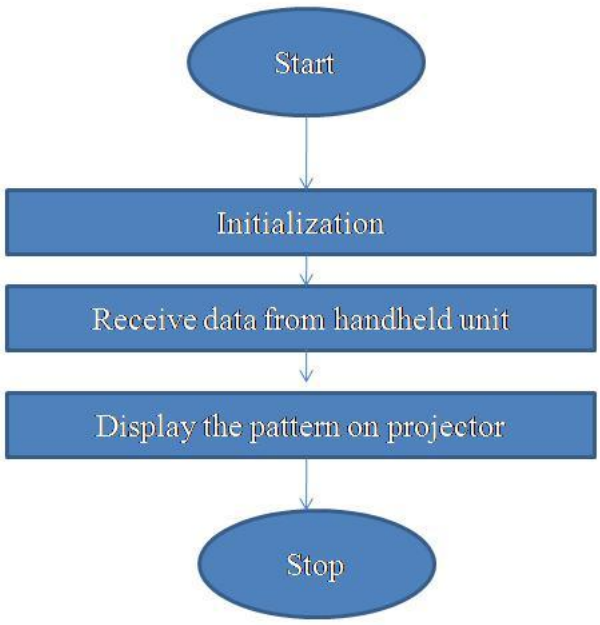


Fig.5 Flow chart for operation of remote unit

IV. OPERATION

Following steps are needed to be carried out for displaying the contents on the projector:

1. Connect Video out pin of Raspberry Pi to Video in pin of projector
2. Connect Zigbee transmitter module to ARM7 board.
3. Connect keyboard and mouse to the USB ports of Raspberry Pi.
4. Provide supply to Raspberry Pi board using micro USB socket provided.
5. Turn on the supply for ARM7 board.
6. Plug in the connector of Supply to turn on the handheld module.
7. Open terminal on Raspberry Pi desktop.
8. Give command

   pythonmoosegesturetest/
9. Mouse gesture test window will appear. Minimize both windows and again open the terminal.
10. Now give command

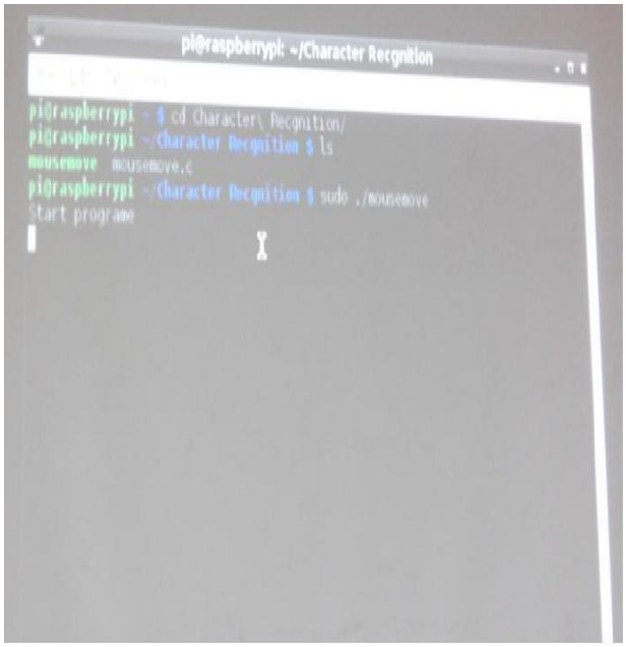
    cd Character/recognition/
    sudo ./mousemove
11. Now, we can make pattern using mouse also.
12. Make patterns on touch screen at the handheld unit. They will appear on the projector at the remote unit.
13. To turn of the terminals give command

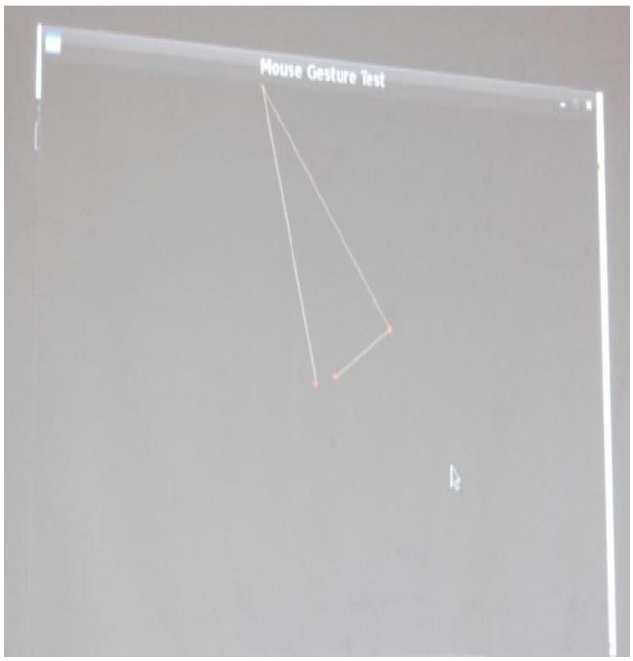
    kill all mousemove

V. RESULT

Proposed design of hand held equipment is build using ARM 7 processor which can interface to wireless module and 7 inch touch screen. The data written on the screen is transferred to PC through RF module. The use of Linux operating system helps in specification for multitasking and also for writing the application software on the kernel. When teacher writes on a book-size touch screen with an electrical pen or finger, handwriting signal will be converted to electrical signal and transferred to the PC terminal software or Raspberry Pi ARM board by RF wireless transmission module in the band of frequency 2.4GHz. Then the PC terminal software/ Raspberry Pi ARM board will process the handwriting signal and display it in a larger form by projector.

Moreover this technology helps in avoiding use of traditional chalk & board thus eliminating health issues caused by chalk dust. This hand-held equipment is cost-effective compared to present interactive white boards and is portable many features.





VI. APPLICATIONS

As board is designed for efficient classroom teaching, its major applications are in schools, colleges or at any level of educational institute, In corporate board rooms, In work groups, In training rooms for professional sports coaching.

VII. FUTURE SCOPE

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.

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.

By interfacing an appropriate memory to the proposed module, we can store the written text and resume it when we want to memorize it.

VIII. ACKNOWLWDGEMENT

This paper has been conducted under the guidance of our tutor Prof. Dr. G. U. Kharat and Prof. Chanakya Kumar Jha Also authors would like to thank the department of E&TC, Sharadchandra Pawar College of Engineering, Otur, Pune.

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