Portable Notepad

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Project Objectives

- To create a device with the capability of receiving text input, displaying and storing the text data.
- The device must possess the ability to retrieve stored information and present a user-intuitive editing interface.

Hardware Configuration

- One 128*64 Monochrome Graphical LCD based on KS0108 controller
- Atmel 24C64 64Kb EEPROM
- Full QWERTY Keypad
- One ATmega32 microcontroller running at 12MHz using external crystal oscillator

• The graphical LCD

The Graphical LCD

•The Graphical LCD allows for control over individual pixels on the screen.

•However, the KS0108 controller does not feature inbuilt functionality for displaying characters.

•Drivers for the LCD were obtained from the GPL-licensed open source library AVRLIB written Pascal Stang.

•However, the drivers were not perfect and suitable modifications had to be made to remove bugs and add extra functionality as required by our project.

- # Keypad Design
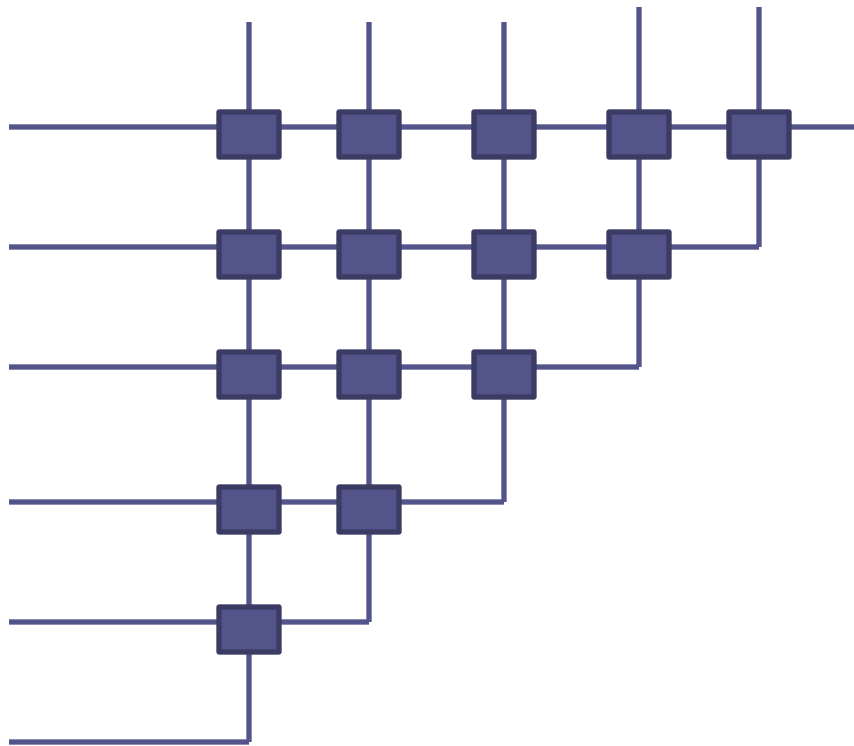
Combinatorial Keypad

- This design allows the implementation of a larger keypad using relatively lesser number of pins on the microcontroller.

- The downside is that detecting keystrokes is complicated and the code to detect keystrokes is non-trivial.

- Any two pins on the microcontroller are selected and connected via a switch. There are total $^nC_2$ such possibilities. Hence the name "combinatorial".

Other hardware considerations

- The device also requires other standard electronic components such as EEPROM, voltage convertor (L75M05), etc.
- The cost to manufacture the project at retail prices of the components is approximately Rs. 1000

Software considerations

From Portable Notepad
To Personal Digital Assistant

Software Features

- Application manager (can be loosely termed as Operating System) with ability to detect and modularly install or remove applications.
- Real Time Clock feature with power-saving sleep mode.
- Current applications include Digital Notepad, USART terminal and Attendance Register.
- Incorporates an API for developing applications compatible with the operating system.

The OS Home Screen

- The Application Manager uses preprocessor directives to detect and automatically install compatible applications at compile-time.
- The application developer needs to write a special header file as per a specified format and a separate source file containing the source code of the application.
- All dependencies that may be required are conveniently included in a separate header file "include.h"
- Currently, a maximum of 4 applications can be simultaneously loaded onto the microcontroller

Real Time Clock

- Uses the internal 16-bit Timer1 of the ATmega32 in CTC mode with Compare Match interrupt enabled.
- Sleep mode uses the ATmega's built-in power saving functionality to shut the MCU core and conserve power.
- The Extended Standby Mode (mode 6) was used in this instance. The external oscillator was, however, kept running.

Digital Notepad

- The original project idea is the most powerful application, with a complete GUI interface implementing cursors, saving and loading onto the external EEPROM in different slots and many user-intuitive features.

Other applications

USART terminal

- Implements a PC-style terminal enabling the transmission and receipt of USART signals.
- Allows for control of any USART-driven device.

Attendance Register

- A practical application which records the roll numbers (in IIT Kanpur format) of students and stores them in the EEPROM
- Records are unaffected if power is disrupted, however, only 256 records can be currently stored.
- *Thanks to Anubhav Singla for the idea of this application.*

Problems faced

- The major problem faced was understanding the unfamiliar environment of AVR Studio and WinAVR while trying to interface the Graphical LCD.
- The keypad code proved to be more difficult than expected and the last bug was detected and fixed almost two weeks after it was written.

Further work

- Implementing application-specific event handlers for interrupt calls.
- Improving graphical capabilities by implementing multiple graphics libraries.
- MP3 Player using MMC cards interfaced via SPI and STA015 MP3 decoder IC.
- Various Personal Information Management (PIM) applications such as Calendar, Address Book, Alarm Clock, etc.

The IIT Kanpur PDA Project

References
- http://www.mil.ufl.edu/~chrisarnold/components/microcontrollerBoard/AVR/avrlib/ for the Graphical LCD and EEPROM libraries

- http://www.extremeelectronics.com for useful tutorials on AVR microcontrollers.

Credits
- The Electronics Club Coordinators
- Our mentor, Palash Soni
- Mr. Rajeev Shankar Sinha for the combinatorial keypad concept