An Embedded EEG Analyzing System Based on \( \mu \text{C/os-II} \)

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Agenda

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• Measurement Device
• Amplifier Design
• Software Design
• Task Configuration
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• Experiment
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Background

- EEG systems traditionally bulky
- Can be used to detect seizures, monitor anesthesia, coma monitoring
System Design

- Two main parts:
  - EEG measurement PC
  - EEG measurement device
Measurement Device

- Amplifier, filter, and A/D conversion before sent to ARM
- Processes event-related potentials (ERPs)
- ERP uploaded to PC
- Uses 8 channels to distinguish eight different simulations
- Synchronized signals of different simulations are recorded then all processed together.
Amplifier Design

- Signals generally in the tens of microvolts range
- Prevent noise while ensuring stability of signals
- MAX4197 used as the HPF with a cutoff frequency of 0.96Hz (adjustable)
- MAX7403 used as the LPF with range of 0.1Hz-10kHz

![Fig. 2. Schematic of Amplifier](image-url)
Software Design

- Based on μC/os-II Real-Time Operating System
- Systems functions divided into five modules
  - Signal Acquisition
  - Data Preprocessing
  - Parameter Setting
  - Order Implementing
  - Data Transmission
- The RTOS establishes a task priority table and breaks down the processes into many smaller tasks
Task Configuration

- Smaller tasks are prioritized into smaller system functions

<table>
<thead>
<tr>
<th>mailbox</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>task</strong></td>
</tr>
<tr>
<td>priority 5</td>
</tr>
<tr>
<td>synchronous data transmission task</td>
</tr>
</tbody>
</table>

- Configuration modes control the transmission

- Connected via USB to PC
Data Structuring

• There are 18 EEG channels to collect data with a speed of 1000 collections per second

• Data is stored in 18 small arrays corresponding with each channel as the Pre_Data

```
typedef struct _PRE_DATA
{
    uint   nDatahead;
    uint   nChannelNum;
    uint8  nChannel_1[3];
    ...........
    uint8  nChannel_18[3];
    uint8  nRespons
}PRE_DATA, *P_PRE_DATA
```
Filtered Data

- The Data is then filtered via STRU_DATA to encapsulate it.

- Every encapsulation has 10 millisecond EEG data and the simulation signals.

```
typedef struct _DATA
{
    int nDatahead;
    int nChannelNum;
    int nDataNum;
    int nChannel_1[N];
    ............  // N=10
    int nChannel_18[N];
    short nRespons [N]
}STRU_DATA, *P_STRU_DATA
```
PC Software Design

• Function of PC is to provide a platform for the EEG data collection, display, and processing.

• It is necessary to adjust cut-off frequency (15-120Hz) of filter for simulation signals.
Data Acquisition Experiment

- EEG signals from 6 Channels
- PC received the signals from the ARM
- ER signals are considerably faint
Conclusion

• By processing and acquiring data on the ARM and making it compatible with a PC through USB the overall system size and power requirements have been drastically reduced.

• System expandable to 128 channels

• Moving forward:
  • Applications of signals
  • Show expandability with 128 channels (slowdowns?)
References

- [http://www.megamedicals.com/small-images/691946.jpg](http://www.megamedicals.com/small-images/691946.jpg)