A multi-channel remote controller for home and office appliances

ADVISER   : Chao-Huang Wei
STUDENT    : Min-Tsang Yang
SN         : M9720101
Abstract

• Multi-Channel Remote Controller (MCRC) for home and office appliances.
• It supports access to controlled environment via:
  – Web Page
  – Smart-Phone (SP)
  – Personal Digital Assistant (PDA)
  – Global System for Mobile (GSM)
  – Telephone lines
Outline

- Introduction
- Overview of MCRC
- Local control unit of MCRC
- Conclusions
- References
Introduction

• Remote controller can be developed with considering of the following issues:
  – Using the available communication channels
  – PC as the main server and an emergency controller

• MCRC (channels + control devices) can be classified in three main categories:
  – Internet (PDA, SP, Web page)
  – GSM (GSM modem and PC)
  – Telephone lines (DTMF and microcontroller)
Overview of MCRC

- User and design considerations

<table>
<thead>
<tr>
<th>User Requirements</th>
<th>Design Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• User friendly</td>
<td>• Common database</td>
</tr>
<tr>
<td>• Common password</td>
<td>• Secure and robust system</td>
</tr>
<tr>
<td>• Feedback signals</td>
<td>• Hardware independent</td>
</tr>
<tr>
<td>• Accessibility in any condition</td>
<td>• PC independent access possibility</td>
</tr>
<tr>
<td>• Information sharing between channels</td>
<td>• Support communications standards</td>
</tr>
</tbody>
</table>
• **Emergency condition**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Control device</th>
<th>Local controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM/Internet interruption</td>
<td>Telephone set</td>
<td>microcontroller</td>
</tr>
<tr>
<td>PC malfunction</td>
<td>PDA, SP, Mobile Phone</td>
<td>microcontroller</td>
</tr>
<tr>
<td></td>
<td>Telephone set</td>
<td></td>
</tr>
</tbody>
</table>

• **Functionality of MCRC**

<table>
<thead>
<tr>
<th>Internet</th>
<th>SP, PDA, Web page</th>
<th>PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM</td>
<td>Mobile phones and networks</td>
<td>PC</td>
</tr>
<tr>
<td>Tel. lines</td>
<td>Mobile and desktop telephone</td>
<td>Microcontroller</td>
</tr>
</tbody>
</table>
• **MCRC**
• **Remote Control Channels**
  
  – **Internet**
  
  *A Web server in local control unit receives the request from remote client.*

  – **GSM**

  *The communication is established by the Short Message Service (SMS) protocol.*

  – **DTMF**

  *The four bit digital output of the DTMF decoder can be used by a PC, microprocessor based system.*
Local control unit of MCRC

• The local control unit of MCRC contains a PC and two microcontrollers.

• The duties of control unit are:
  – receiving commands from user
  – detecting and interpreting this command
  – sending the result to devices
  – informing the user by feedback signals
• **Microcontroller based local controller**

![Diagram of a microcontroller-based local controller system.](image-url)
The main objectives of PC in MCRC are as follow:

- Receiving commands from Web or mobile client
- Updating the database
- Sending feedback messages to user
- Communication with LDC for data change
• The jobs of this controller in MCRC are as follow:
  – Ring counting and line connection control
  – Receiving and interpreting commands
  – Sending the control commands to LDC
  – Control of voice memory in playback/record modes and sending feedback messages to user
  – Recording the last changes in memory
  – Communicating with LDC for data exchange
• Microcontroller based control circuit
A. Communication between Controllers

- PC and main controller communicates with LDC are connected via TX and RX lines.
- LDC works as master controller and manages communication between controllers.
- Each slave sends two different codes as response to the master request.
Flowchart of serial communication in MCRC

1. Start
2. Turn off devices
3. Send F0 via TX
4. Read Rx
5. If response is Y, go to:
   - If Input == E0, send password, load states to PC
   - If User is in line, receive last changes from PC
6. If response is N, go back to step 3.
Send 0F via TX

Read Rx

response

Y

Input == 0E

N

Send password, load states to M. controller

N

User is in line receive last changes from controller

Y
B. Software Architecture

- **N-Tier application architecture is used in development of software.**

  ![Diagram of N-Tier Architecture]

  - **Presentation Layer (PL/UI):** Controls, Forms, Images, Media
  - **Business Logic Layer (BLL):** Security, Rules, Calculation, BLL Data
  - **Data Access Layer (DAL):** Data API, Stored Procedures
  - **Data:** Tables, Views
C. .Net Platform

C# code

Compiler

VB code

Compiler

C++ code

Compiler

Common Language Infrastructure

Common Intermediate Language

Common Language Runtime

01110011001111

11001010001100
D. System Modules

- **Mobile Client**
  - Web server is used for mobile client connection.

- **GSM Module**
  - AT (Attention) command through GSM modem.

- **Database**
  - It has been utilized for storing password and device status information.

- **Server Modules**
  - collect information from clients + sends values to LDC + listens to the serial port.
• **Web site (login and device status)**

![Login Form](image)

<table>
<thead>
<tr>
<th>Machine</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Television</td>
<td></td>
</tr>
<tr>
<td>Air Condition</td>
<td></td>
</tr>
<tr>
<td>Garage</td>
<td></td>
</tr>
<tr>
<td>Lights</td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td></td>
</tr>
<tr>
<td>Music</td>
<td></td>
</tr>
<tr>
<td>Heat</td>
<td></td>
</tr>
<tr>
<td>Washer</td>
<td></td>
</tr>
</tbody>
</table>

• **Mobile client (login and device status)**

![Mobile Client](image)
• Home server screen shot
Conclusions

• A **MCRC** for home and office automation was designed and implemented on prototype circuit.
• The designed system will work as an effective **RC and Monitoring System**.
• It can access the controlled environment via tel. lines by using **DTMF based control circuit**.
• It can also be used for RC control of many industrial devices.
References

Thanks