Web-Based Home Appliances Controlling System

B.E. EXTC, TSEC

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Agenda

- House monitoring using a live feed
- Advanced security system based on user-authentication
- Alerting emergencies and critical situations
- Controlling common appliances
- Applications in social gatherings/functions
- Incorporating voice recognition to accommodate a wider audience
Product Significance and Utility

- A system which gives the user complete control over all remotely controllable aspects of their home
- The USP of this system would be the usage of the Internet, thus making it accessible via any web-powered device
Communication Levels Overview

- **Level 1**: data feeder/acquisition
- **Level 2**: interface
- **Level 3**: server
- **Endpoint**: user
End Point

Level 3

web accessible devices

windows/linux web server with services

Level 2

802.11 WLAN

802.3 Wired LAN

802.15.X Bluetooth, ZigBee

Level 1

camera

sensors

GPRS module
Application 1: Camera Feed

• To monitor general and children activity at home, especially for working parents

• Can be implemented as live feed or as periodic intervals

• By means of web controlled cameras, we can adjust the view range, brightness, zooming and other aspects

• **Software**
  - HSTouch client (platform independent)

• **Hardware**
  - Ethernet or WiFi “Net”cams (webcams which be directly interfaced with the internet)
Application 2: Advanced security system based on user-authentication

- Similar to an OTP system for online banking, we propose an email based dual password, door opening system

- **Mechanism**
  - The first password sent to the system via email is a request that the system should send a OTP for unlocking the door
  - The user responds with the OTP password received from the system thereby authenticating the user
  - An acknowledgment is passed on to a specific user upon authentication to prevent hacking attempts

- **Hardware**
  - The system communicates using a GPRS Module

- **Usage**
  - Remotely allow access to the home for contractors or repairmen
Application 3: Alerting emergencies and critical situations

- A common situation in Indian homes (in particular), is the concern that appliances such as the burner gas, geyser or a boiler if left switched on, upon leaving home would have a disastrous effect.

  - **Mechanism**
    - The density of Butane (cooking gas) can be detected and appropriate action can be taken and thereby a nasty situation can be prevented.
    - A geyser if left unattended for a period of time greater than a certain threshold, it will switched off instantly and the user would be notified via email through the web based system.

  - **Hardware**
    - A gas density sensor placed in the kitchen can be used for excess Butane detection.
    - The sensor sends the data to base transceiver which processes the data and sends it to the server.

  - **Usage**
    - Similarly it can be used to alert and contact the fire department, in case of any emergency situation such as fire breakout.
Application 4: Controlling common appliances

- Consider the scenario where a working person when returning home, would want an ambient temperature and environment.

- **Mechanism**
  - The user emails the system well before he/she reaches home, in order to switch on the air-conditioner and sets the temperature.
  - By the time the user steps into his/her house, he would have a suitable atmosphere.

- **Hardware**
  - The system communicates using a GPRS Module.
  - Using a temperature sensor, a thermostat system can also be implemented.
Product Feasibility and Costs

• Considering our product will be aimed at the common Indian audience, the USP of our system is the aim to accomplish our hardware and software requirements as a minimal cost solution.

• **Total Product Requirements**
  - GPRS Module
  - Camera for live surveillance
  - Gas sensor
  - Temperature sensor
  - A common PC with free server software (such as Apache, nGinx web-server software)
  - Open-source software such as the HSTouch client (for camera feed implementation)
Product Scalability and Upgrades

• Our system would be using a home PC as a webservice using appropriate software since availability of a PC is the norm in every common Indian home today

• Our system can be extended and scaled by using a specialized IBM or HP web server to enhance the QoS, efficiency and provide dedicated resources

• Better (and expensive) sensors can be used to improve resolution, response-time and sensitivity

• Extending the product to be capable of using a web-based GUI Interface via a static IP and display a menu to perform tasks such as:
  - camera display, view change, luminance change etc
  - obtain real-time data from the sensors and view it on the web-interface
  - control appliances (switch on and off) through the GUI itself
## Technical Specifications

<table>
<thead>
<tr>
<th></th>
<th>ZigBee</th>
<th>Wi-Fi</th>
<th>Bluetooth</th>
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<tbody>
<tr>
<td><strong>Range</strong></td>
<td>10-70 meters</td>
<td>10-150 meters</td>
<td>10-60 meters</td>
</tr>
<tr>
<td><strong>Networking</strong></td>
<td>Ad-hoc, peer to peer, star, or mesh</td>
<td>Point to hub</td>
<td>Ad-hoc, very small networks</td>
</tr>
<tr>
<td><strong>Topology</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Operating Frequency</strong></td>
<td>868 MHz (Europe)</td>
<td>2.4 and 5 GHz</td>
<td>2.4 GHz</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>900-928 MHz (NA), 2.4 GHz (worldwide)</td>
<td></td>
<td></td>
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<tr>
<td><strong>Complexity</strong></td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>Very low (low power is a design goal)</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Consumption</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Security</strong></td>
<td>128 AES plus application layer security</td>
<td>Wireless LAN connectivity, broadband Internet access</td>
<td>64 and 128 bit encryption</td>
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<td><strong>Typical Applications</strong></td>
<td>Industrial control and monitoring, sensor networks, building automation, home control and automation, toys, games</td>
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<td>Wireless connectivity between devices such as phones, PDA, laptops, headsets</td>
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For low range usage, ZigBee is preferred due to the usage of AES, whereas for high range usage, WiFi is the obvious choice.
Product USPs and Conclusion

- We have seen many applications of the proposed system while also considering the cost efficiency of the system.
- The estimated cost of all technical articles would be around Rs. 5,000.
- The components chosen (sensors + devices) are readily available.
- We have targeted day-to-day problems and common practical issues through our proposed system.
- We have sought solutions by using a minimal framework consisting of a webserver, web powered device and a data interface. By using appropriate sensors (like temperature, gas) and devices (cameras) we have proposed our system.
Problems and Solutions

• **Security**
  – The central webserver can be hacked and a perpetrator can misuse the resources
  – The interfacing mechanism being used, such as Ethernet (wire-tapping), WiFi (password cracking), Bluetooth (bluejacking/bluesnarfing), ZigBee (frequency hopping attacks and spoofing)
  – If a GUI is implemented on a static IP, an SSL connection can be established to prevent data interception

• **Hardware faults**
  – Failure of hardware such as sensors can cause the system to be rendered dysfunctional
Questions are welcome . . .