RemindMe: Home Reminder System

ECE 445 SENIOR DESIGN
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Statement of Purpose

Living with family members or multiple roommates means splitting up the chores that it takes to maintain a household, but the common problem that arises is people forgetting to perform household tasks. Our project RemindMe, is an alert system that provides audiovisual reminders to users who are physically nearby the chore that needs to be done. Users place a RemindMe “Station” near the chore location and configure the station to be manually triggered or set the reminder frequency based on either time of day. The system is networked with a central server, the RemindMe “Hub” that manages the Stations in the household, directly interfacing with the user through a smartphone application.

Goals & Benefits

- Easily divide chore responsibility between roommates.
- Provide gentle audio-visual reminders of tasks that need to be performed.
- Eliminate waste caused by redundant performance of tasks.

Functions and Features

- Assign tasks to specific members and track completion by members.
- Determine status of tasks by reading sensor and input data from Stations
- Output audiovisual signal if a task is incomplete and person is nearby.
- Fetch user submitted detailed information about a task through NFC Tag.
- Central task monitoring from RemindMe Hub.
- Prevents energy waste by only reminding when people are nearby.
- Connect multiple RemindMe Stations for convenience.
- Stations powered by standard coin battery cell.
- Hub powered by wall socket connection.
- Night Mode will disable reminders during certain time periods
- Stations will detect and report when their batteries are low.
Block Diagrams

Top Level Block Diagram

Figure 1. Top Level Block Diagram

- Wireless Data:  
- Wired Data:  
- Power:
Circuit Schematics
Remind Me Hub

Figure 2. RemindMe Hub Circuit Diagram
Block Descriptions

Wi-Fi Module

A 2.4 GHz wireless communication module used for communication between the RemindMe Hub and either home Wi-Fi or directly with a user’s phone. The ESP8266 offers easy programming in Lua or C as well as a rich feature set already integrated into the firmware. The MCU will communicate with the Wi-Fi module over UART for ease of implementation and debugging. Packet information will be discussed in the Android Application block description.

ESP8266 Highlighted Features:

- Built-in TCP/IP stack with the 802.11 b/g/n protocols.
- Offers SPI, SDIO 2.0 and UART communication options.
- Built-in low power CPU to offload packet processing from core MCU.
- Standby consumption power of <1.0 mW.
- Rich documentation and example projects online.

*Figure 3. ESP8266 Circuit Diagram*
Calculations
Power and Battery Life

Battery life--battery life is calculated based on the current rating in mA per hour. The battery life or capacity can be calculated from the input current rating of the battery and the load current of the circuit, which depends on the electrical components that consist of the circuit.

Battery life = Battery Capacity in mAh / Load Current in mA * safety factor

We can estimate load current from the ratings of each component in the Station during standby mode and active mode if we make assumptions about the relative active time for each component.

Parameters
RemindMe Unit:
- MCU
  - 290uA max active mode
  - 1.9uA standby mode
- IR sensor
  - 50uA
- 2.4 GHz communication
  - 14mA active
  - 22 uA standby mode
- LED
  - 2 mA active
  - Negligible standby current
- 3V battery capacity = 240 mAh

RemindMe Hub:
- Voltage regulator
  - Up to 10mA
- 2.4 GHz communication
  - 14mA active
  - 22 uA standby
- MCU
  - 290uA active mode.
  - 1.9 uA standby
- Wi-Fi module = 200 uA max active mode. standby = 1.2 mA
- LED
  - 2 mA active
  - Negligible standby current
- DC powered
Calculations

Worst case battery life for RemindMe Unit:
\[
\frac{240mAh}{(0.290 + 0.05 + 14 + 2 \times 3)} \times 0.7 = 8.26 \text{ h}
\]

Standby battery life for RemindMe Unit:
\[
\frac{240mAh}{(0.0019 + 0.05 + .022)} \times 0.7 = 135.32 \text{ days}
\]
## Requirements and Verification

### Android Application

<table>
<thead>
<tr>
<th>Android Application</th>
<th>Verification Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set reminder frequency to repeatedly trigger task incomplete.</td>
<td>Before all verifications, power on RemindMe Hub and Station and place into debug mode via push button. Open RemindMe Android Application. Verify the application lists one Station and indicates connectivity to the Hub.</td>
</tr>
<tr>
<td>Set task status manually from the app marks task incomplete.</td>
<td>In the application, create a reminder for a 2 minutes in the future and the application should respond with a notification that the reminder triggered between 2-3 minutes in the future.</td>
</tr>
<tr>
<td>Display current status of tasks.</td>
<td>In the application, create a task and set it manually incomplete. The application should respond within 1 minute that the reminder was triggered.</td>
</tr>
<tr>
<td>Display additional task information for a station within the app.</td>
<td>Power on second RemindMe Station and place into debug mode via push button. Manually create and verify that task status is incomplete for 2 connected Stations. Complete a task on one Station. App should update status for only that Station within 1 minute.</td>
</tr>
<tr>
<td>Display tasks completed by household members.</td>
<td>Add a text detail to a task using the app interface. Using NFC on that station should display the information on the application within 15 seconds.</td>
</tr>
<tr>
<td></td>
<td>Add a user to the household. Complete task and claim completion using NFC verification with the app. The record keeping within the application should display the user’s claim within 1 minute.</td>
</tr>
</tbody>
</table>

Table 1. Android Application R&V Table
Safety

Our project has two major physical components: The Station and the Hub. Each of these offers unique safety challenges around the way they are powered and the way that they communicate with each other and external devices.

The Station is a low power device driven by a coin cell battery. As a low voltage device without high energy storage, there is minimal risk of physical damage. Still, we must ensure that:

- Prior to use, batteries should be new and undamaged
- Do not short circuit battery across VCC and GND
- Battery is installed with correct polarity
- Only leave batteries in a safe, climate controlled environment (0-50°C)
- Do not discharge battery below safe operating voltage (1.8 V)
- Do not draw more than safe maximum current from battery (1 A)
- Do not attempt to recharge coin cell battery
- Do not draw more current per pin than the MCU maximum (6 mA)
- Ensure no significant wireless interference with other equipment through Bluetooth (2.4 GHz band)

The Hub is essentially a router and wireless server without the strict energy restrictions as the Station. We will be converting wall socket 120 VAC to 5 VDC before the power reaches our PCB, so we will consider our safety requirements from the 5 VDC source onwards. We must ensure that:

- We do not draw more than safe maximum current from 5 VDC converter (3 A)
- We do not draw more current per pin than MCU maximum (6 mA)
- Ensure no significant wireless interference with other equipment through the 2.4 GHz band
Ethics

Our project follows IEEE codes of ethics as following:
[1] To accept responsibility in making decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment.
[3] To be honest and realistic in stating claims or estimates based on available data.
[5] To improve the understanding of technology; its appropriate application, and potential consequences.
[6] To maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations.
[7] To seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others.
[9] To avoid injuring others, their property, reputation, or employment by false or malicious action.
[10] To assist colleagues and co-workers in their professional development and to support them in following this code of ethics.
References


