Solar Door Panel

Jeff Kelley
Tyson Hunt
David Hurst
Overview

Normal Door Signs are boring and lame!

- Functional Description
- Tasking
- MCU, Display, and Radio
- Energy Harvester and Power
- Software Applications
- Parts List
- Schedule/Risks

Functional Description
Tasking

Tyson
MCU, Display, Radio and communication.

David
Energy Harvester, Power management, PCB & Packaging

Jeff
Server, Web Interface, and Android App
Flexible Energy Management System

• 20 nA @ 3 V Shutoff Mode
• 0.6 μA @ 3 V Stop Mode
• 0.9 μA @ 3 V Deep Sleep Mode,
• 45 μA/MHz @ 3 V Sleep Mode
• 180 μA/MHz @ 3 V Run Mode
MCU Schematic

Note
In the block diagram, color indicates availability in different energy modes.
Device:
1) Wake up every x time
2) Send ready signal
3) Wait y time for response from server
4) If response
   I) Get data
   II) Send data
   III) Receive Done signal
5) Sleep
6) Repeat steps 1-6

Server:
1) Wait for ready signal
2) Send acknowledgement once received
3) Send data
4) Receive Data
5) Send done signal
6) Repeat steps 1-6
Data Transmission Structure

CMD's
- Update
- Status
- Metrics
Failure Protections

User Settings
- Enable Components <-> Has Power
- Save power statistics (onboard)
- Critical Level
- Backup Battery
- Manual Wakeup
Harvesting Solar Energy

-Solar Panels output voltage varies

-What if there is no light?

-Need to charge caps at their rated voltage

-Protection from overcharging storage device
Energy Harvester

TI BQ25504 Usage & Dev Kit

Images from http://www.ti.com/product/bq25504
Smart Energy Management

- TI BQ5504 Low Power Boost Charger
  - Programmable Dynamic Maximum Power Point Tracking
  - .25V - 5.25V Output
  - As low as 80mV Input
  - Can warn of pending power loss
Power Consumption

**Power Draw:**
- RF: 18mA Rx, 25mA Tx
- MCU: 180uA/Mhz Run, .9uA Sleep
- Display: ~300mJoules (150mW for 2 seconds)
  - Sleep Mode 10uA
- Regulator: 20uA - 100uA
- Energy Harvester: 300nA

**Power Source:**
- Solar Panel: 6V, 3 Watt Amorphous
Power Metrics

- Battery OK line will tell MCU status of charger
- Toggles differently if charging or discharging
- MCU will read capacitor voltage levels before and after update

~5V

~4V

Image from http://www.batteriesinflash.com
Server & Software

- Convert picture or HTML file for transmission
- Display power consumption metrics
- Display Web Interface
Web Page Prototype

Preview of what will be displayed

SoDoPa

Jeff Kelley
David Hurst
Tyson Hunt

Power usage metrics
Finalized BOM

MCU + RF: Gecko EFM32 + CC2520
RF to USB Adapter: Teensey 2.0
Display: 5.7" 320x240 Kent Display
Energy Harvester IC: TI BQ25504
PCB: Manufacturing, Assorted Resistors/Capacitors
Solar Panel: 6V 3 Watt Amorphous
Super Capacitor: Panasonic S5R5H155 (5.5V 1.5 Farad)
Voltage Regulator: ST LD39050XX LDO
Schedule

- Web Server: Jeff
- PCB schematics: Dave
- Image processing: Jeff
- PCB assembly: Dave
- Radio Server Interface: Jeff[50%], Tyson[50%]
- HTML Parse and render: Jeff
- MCU to Display interface: Tyson
- MCU Power Management: Tyson
- Integration Testing and Packaging: Dave, Jeff, Tyson
- Radio Server Communication: Jeff
Risk Assessment

- MCU Radio Driver
- Radio Range/Throughput
- Super Capacitor Discharge Rate
- Limited Power
Demo Day

- Portable display
- Server on a laptop
- User displays text from GUI
- Show Logo
- Set sleep time to ~1min -> update?
- Show power usage/Settings
- Disconnect Solar Cells -> Backup Battery

Hopefully all components run on Solar Cells only!
Questions?