Bluetooth Enabled eWalker
Team 4

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Agenda

- General Introduction
  - Design
    - Smartphone Subsystem
    - Control Subsystem
    - Power Subsystem
  - Conclusions from the Project
  - Future Ideas
  - Questions
Motivation

Technological Advancement
- Smartphone interface is very common
- Walkers left behind

Problems with existing designs
- Lighting and charging features
- Flashlights
- No IoT
Solution - High Level Requirements

Button Functionality
- Initiate calls/texts within 8 seconds

Messaging System
- Send different text messages based on the severity of the situation

Power Unit
- Rechargeable battery pack of 20800mAh capacity
- 5V 2A USB Type A charging ports
- Provide 9V 1A to the control unit.
Visual Aid

- Gyroscope
- Power Supply
- Bluetooth Module
- Text/Call Contact 2
- Emergency Call
- Text/Call Contact 1
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Block Diagram
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Smartphone Subsystem - eWalker Application

Configure Text Messages

- Configured Text Message for Contacts:
  Hello, this is an automated text message from an eWalker. You are my configured contact. I am in need of assistance. Please follow the GPS address to assist me.

- Configured Text Message for Detected Fall:
  EMERGENCY: This is an automated text message from an eWalker. The walker has detected a fall has occurred. Please try to contact me or follow the GPS address to assist me.

[Options: Update Configured Messages]

Contact 1
708894061

Contact 2
8478882554

Emergency Services
8476258949

Tap Here to Edit Contacts

Enter Updated Phone Number:
Ex: 18007099999

Update Contact

1.) Configure Bluetooth
Select BlueTooth Device

2.) Start Walking

[Map with location marker]

Flag Value: 00False
Hint for TextBox: 0

[Options: Back, Next]
### Smartphone Subsystem - eWalker Application Bluetooth

<table>
<thead>
<tr>
<th>Flag Value</th>
<th>Logical Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Do Nothing</td>
</tr>
<tr>
<td>A / B</td>
<td>Text Contact 1 / Contact 2 Configured Message</td>
</tr>
<tr>
<td>C / D / E</td>
<td>Call Contact 1 / Contact 2 / Emergency Services</td>
</tr>
<tr>
<td>Z</td>
<td>Text Contact 1 AND Contact 2 Configured Emergency Text Message</td>
</tr>
</tbody>
</table>
Smartphone Subsystem - Challenges

- Properly configuring API for text messages.
- Initializing Bluetooth pairing
- Permissions with direct calls
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Control Subsystem - ATMega328P-PU PCB

- Power supply, Connectors, LED Drivers, Microcontroller
- Replicates functions of an Arduino Uno
- Collect and process data from PCB, push buttons, and gyroscope

PCB Layout

Dimensions:
- 80.3mm
- 76.9mm

PCB Schematic
Control Subsystem - HC-05 Bluetooth Module

- SoftwareSerial package on Arduino IDE converts ASCII
- Only TXD is required to transmit data
- Receives power from microcontroller
Control Subsystem - Gyroscope

- GY-521 MPU6050 6-axis gyroscope sensor
- Interfaces with the ATMega chip to send signals to the bluetooth module
Control Subsystem - Gyroscope

- Code adapted from provided source code
- aZ and aY variables are used for orientation tracking
- Values >15000 or less <-15000 for 8 seconds trigger an emergency text
Control Subsystem - Text/Call Push Buttons

- Used E-Switch TL1105AF100Q model for our buttons
- Left and right side designated for contact 1 and 2 respectively
- Center designated for emergency call
Control System Challenges

- Stabilizing the signal communication between the ATMega and the eWalker application
- Code upload to the ATMega chip
- PCB layout and soldering
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  - **Power Subsystem**
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Power Subsystem - Rechargeable Battery Pack

- USB Port Terminal
- BQ2057 Li-Ion Charger IC
- Battery Life Indicator Terminal
- Power Switch Terminal
- In-line 5A fuse

- 4x 18650 two cell battery Holders
Rechargeable Battery Pack

- Consists of eight UltraLast 18650 Lithium Ion Batteries
  - Each cell rated for nominal 3.7V and 2600mAh
  - Parallel connection, 20800mAh total capacity
- The control system consumes about 400-500mA, allowing for almost two days of continuous operation.
- The batteries are manually balanced with the use of an external charger.
Rechargeable Battery Pack

- **Battery Life Indicator Unit, LM3914**
  - Minimum threshold at 3.2V is set to prevent discharging the lithium batteries further below the typical suggested minimum, which is below 3.0V.
  - Each LED represents a 10% voltage change, with 1 LED being baseline at 3.2V and 10 LEDs being 4.2V.

- The pack is isolated from the control system with the use of an illuminated rocker switch in addition to a 5A inline fuse.
Power Subsystem - DC-DC Boost Converter

- 1.5μH Inductor
- Input/Output Decoupling Capacitors
- MP3429
- 9V Output Terminal
DC-DC Boost Converter

- **MP3429 High Efficiency, Fully Integrated, Synchronous Boost Converter**
  - Powers the control unit PCB and output charging ports
  - Manufacturer provides a reference DIY schematic
  - Configured for 2.7V - 4.2V input to output 9V 3A (27W) average power

![Boost Converter Diagram](image-url)
Power Subsystem - Output Charge Ports

- Input/Output Decoupling Capacitors
- L78S05
- Optional Fixed Current Resistor
- Output Charge Port Terminals
Output Charge Ports

- **L78S05 Voltage Regulator**
  - 9V input from boost converter output to 5V 2A output
  - USB Charging
    - 5V required, smartphone circuit adjusts input current
  - Load Resistor limits max 2A output current

\[ i_o = V_{in}/R_1 + V \]

**Fixed current output circuit**
Power System Challenges

- On-board Input Charging Circuit
  - BQ2057 Li-Ion Charging IC replaced with external battery charger
- Soldering
  - Boost Converter Circuit SMT soldering
- USB Output Charging
  - USB devices are able to be charged, but not at the desired rate
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Conclusions

Accomplishments

- Fully functional product meeting high level requirements
- Kept the general walker’s functions unchanged
- Built our own Arduino
- Charging capabilities
- GPS positioning

Takeaways

- Plan ahead
  - Lower costs
  - Time to fix errors
- Find team members strengths
- Importance of following IEEE and ACM Code of Ethics
- Be specific in stating product expectations and liability
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Future Ideas

- Phone mount
- Phone camera live stream
- IR proximity sensor
- Hidden wires and built in buttons
- Smaller microcontroller and enclosure
- On-board quick charger
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