MEDSsense:
A Medication Management Device
Team 7
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RERC on AMI Senior Design Project
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Outline

- Introduction
- Current Market
- Clients
- Design
- Budget
- Timeline
- Conclusion
Too Many Pills!
Insufficient Medicare

- Medication Management Programs
  - No “Checks and Balances”
  - No Dosage Control Systems
  - No Third Party Involvement

- Home Healthcare Assistance
  - No Daily Notifications
  - No Medication Preparation (i.e. cutting…)
  - No Feedback
Current Market

- MarketMed-Time Automatic Pill Dispenser:
  - Releases medication at prescribed times
  - Too small for people with motor skill problems to use
  - Does not send offsite alert or cut pills
Current Market

- Monitored Automatic Pill Dispenser MD2:
  - Alarm system, offsite alert
  - Bulky and expensive
  - Incapable of cutting pills in half
Patents

- **PILL DISPENSER WITH REMINDER (6,581,797)**
  - This device has the ability to program and store many pills. Using a push button one dosage of medication can be released. The problem concerning with this device is that ability to cut the pills.

- **ONE DOSE AT-A-TIME PILL DISPENSER AND CONTAINER HAVING SAME (7,100,797)**
  - This device has the ability to dispense one dosage of medication at a time. Attacking as bottle cap this device is our closest competitor. It is lacking the ability to cut the pill into the correct dosage.

- **CASSETTE FOR DISPENSING PILLS (7,225,597)**
  - This device has the ability to hold many pills. The downfall for this device is that it does not dispense any of the medication or cut the medication into the correct dosage.
Carefully Manage Medications

MEDSense will...

- Provide Notifications
- Provide “Controlled” Dosages
- Correctly Prepare Medications
- Provide Feedback
- Notify Third Party Medical Professionals as Necessary
Clients

- 8 clients with a wide range of disabilities including
  - Diminished hand strength and control
  - Hearing loss
  - Vision loss
  - Memory loss
  - Hand tremors
- All clients connected by desire to remain independent
Subunits

- Design
- Cutting Mechanism
- Multi-Modal Alarm
- Offsite Alert
- LabVIEW Program
Design

- Medication
- Push Button
- Cutting / Dispensing / Notification / Alert Area
- LED Alert Light
Internal Design

- Rotating motor
- Linear actuator
- Motor to cut the pill
- LED alert system
- Pill exit
- Pill chute
- Hole to dispense pill
- Pill supports
- Rotating axis
- Rotating motor
- Batteries and electronics
- Medication
1. The first step in using the MEDSense device is to remove the bottle cap for the medication bottle.
Operation

2. Rotate device 180 degrees and place the device on top of the medication bottle.

3. Twist device normally as if using a regular bottle cap to lock and secure the device to the medication bottle.
4. Then rotate the device 180 degrees, so that the medication bottle is sitting on top of the device.
Cutting Mechanism

- Pills pulled through funnel by gravity
- Movement controlled by rotating discs with holes
- Cut by linear actuator
- LED sensor ensures pills are in correct position
Cutting Mechanism

- Positioning and timing of discs controlled by microprocessor
- Enables control so only one pill moves through system at a time
- Allows for dispense of combination of whole and half pills
- One motor controlling both discs minimizes space and power
Cutting Mechanism

- Force testing done using Tinius Olsen
- Increase in speed, decrease in force needed
- Linear actuator motor with minimum force of 4 lbs (17.8 N) and speed of 20 in/min (0.0085 m/s)
MEDSense Processing Control

- PIC 12F675* Microcontroller
  - In Circuit Serial Programming (ICSP)
  - 25mA Output
  - Internal Clock
  - Analogue Comparator
  - 64 Bytes of RAM
  - Electrically Erased ROM (EEROM)

*12F767 may be used for additional processing
Tri-Sensory Notification System

- Mechano-Sensory:
  - Pulsed Vibrations
  - “Pancake” micro-vibrator motor (Linglong Electric Company)
  - Mimic Cell Phone Design
Tri-Sensory Notification System

Visual:
- LED Arrays
  - Green (Solid): Medication Time
  - Green (Blink): Error Response
  - Red (Solid): Medication is Ready

Vibration
Electrical Perspective:
Tri-Sensory Notification System

- **Auditory:**
  - **Text-to-Speech Module** (Devantech, Acroname Robotics)
    - Compact <2”x2”
    - Built in Speaker
    - 30 programmable text strings
    - Requires 80mA current- current amplification

- **Vibration**
Third Party Notification

- **Wireless Communication**
  - **Bluetooth** (RCM3100, EmbeddedBlue eb506-AHC-IN Bluetooth Radio Module)
    - 2.4GHz Range
      - Signal Filtration
      - Frequency Hopping

- **Communicate with**
  - cellular devices (phone, pda, etc.)
  - Send EMail via Microsoft Outlook®
Pharmacist Interface

- Elements
  - # of pills per dose
  - # of dosages
  - Refill Date
  - Dosage Times
  - Emergency Contact Information
  - Instructions
  - Program Button
  - Program Indicator

Pharmacist Interface Instructions:
1. Enter the number of pills per dose
2. Enter the number of dosages
3. Enter the desired dosage times
4. Fill in the required emergency contact fields and verify the information.
5. Once finished click the program button to program the device.
6. If the device is programmed successfully, the indicator to the right will become green and a “Program Successful” message will be seen.
7. If the device is not programmed successfully, the indicator to the right will become red and a “Program Unsuccessful” message will be seen.
## Budget

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<thead>
<tr>
<th>Component</th>
<th>Manufacturer</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Bluetooth Kit</td>
<td>Rabbit Semiconductor</td>
<td>$339</td>
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<tr>
<td>PIC 12F675 Microcontroller</td>
<td>Microchip</td>
<td>$2.00</td>
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<td>Pushbutton</td>
<td>Honeywell Sensing and Control</td>
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<td>Text-to-speech module</td>
<td>Acroname Robotics</td>
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<td>PCB Board</td>
<td>PCBexpress</td>
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<td>Vibrating Micromotor</td>
<td>Linglong Electronics</td>
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<td>Photodetector</td>
<td>DigiKey</td>
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<td>AN589 PIC Programmer</td>
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<td>Resistors</td>
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<td>Capacitors</td>
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<td>LM75L08 Voltage Regulators</td>
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<td>MAX232 chip</td>
<td>Texas Instruments</td>
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<td>Linear Actuator Motor 42DBL20C2B-L</td>
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<td>Rotational Motor Slotted BLDC</td>
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<td>Materials for casings, discs, etc.</td>
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<td><strong>Total Cost:</strong></td>
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<td><strong>$899.62</strong></td>
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Timeline

- Prototype: Jan 13 – Jan 23
- Bluetooth: Jan 23 – Feb 28
- Text to Speech: Feb 1 – Feb 18
- Microcontroller: Jan 23 – Feb 28
- LabVIEW: Feb 1 – April 30
- Machining: March 1 – April 1
Conclusion

- Easy-to-use design for patients with disabilities
  - Multi-modal alerts, refill reminder, offsite alert
- Simple design reduces risk of error
- Safe and environmentally friendly
- Relieves patient’s stress in daily medication regimen
Acknowledgements

- Dr. Enderle
- David Price
- David Kaputa
- RERC on AMI