Design of "Pack Pal" System to Help Patients with a Severe Mental Illness Quit Smoking

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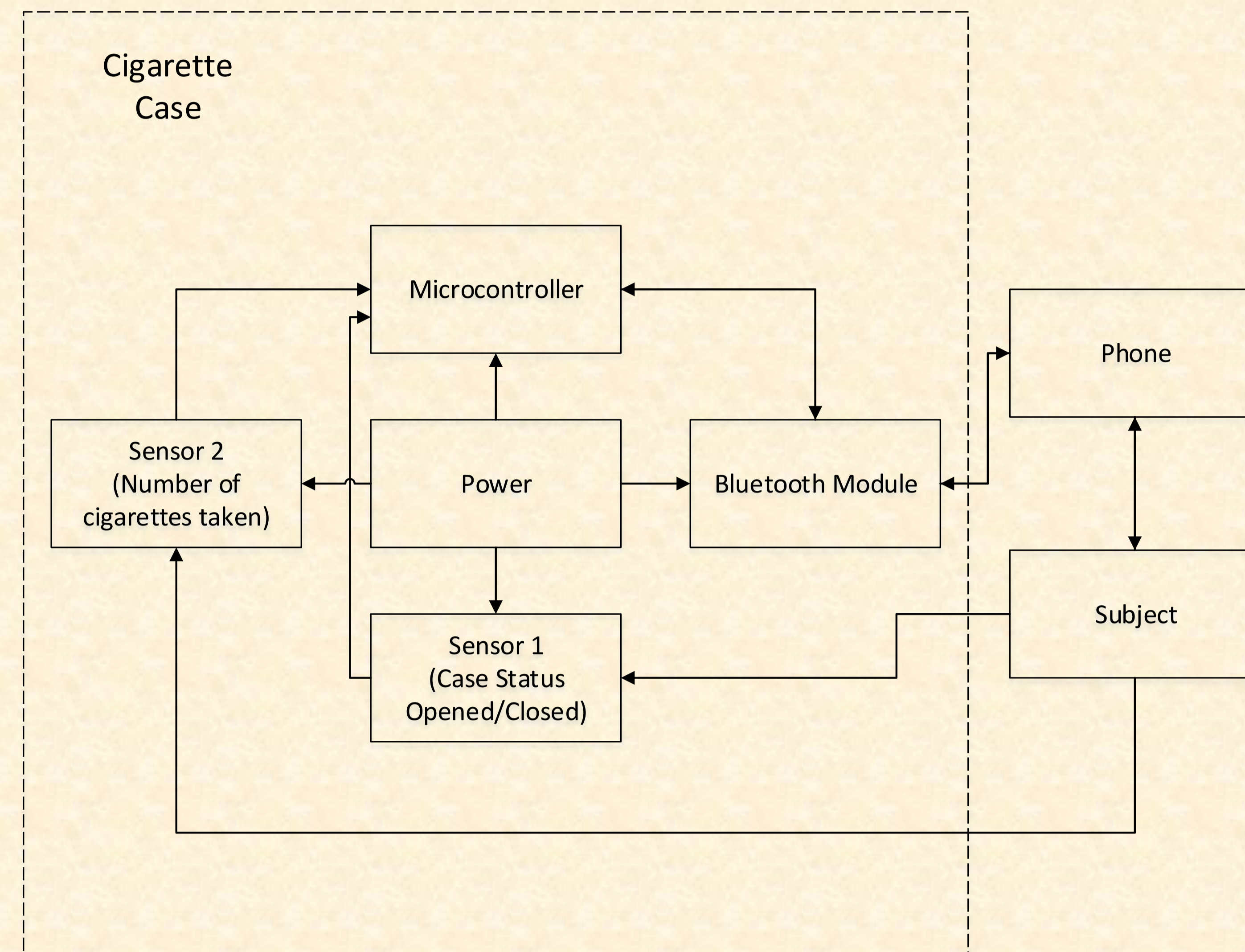
UW BME Design

Abstract

We propose a design for a system, called the Pack Pal, to help patients with a severe mental illness quit smoking. The system consists of a cigarette case and a smartphone application. The case is equipped with multiple tactile switch sensors that will be used to determine when the case is opened or closed and when a cigarette is removed. Upon being accessed, the case interacts with the smartphone wirelessly via Bluetooth (v4.0), sending ASCII characters corresponding to sensor activation. Each time the user accesses the case, the smartphone application will take the data sent from the case and format it appropriately.

A copy of the formatted data will be reported weekly to the patients healthcare professional. Data will also be available through the smartphone application in an easily accessible and understandable manner for the users to monitor their progress throughout the quitting process. Over time, the users will gain knowledge about their smoking habits and will be able to hold themselves accountable for their cigarette use. They will practice distraction techniques (e.g., playing a video game, listening to music or engaging in another related activity), to deter them from smoking.

Background

Tobacco addiction in patients with an SMI (Severe Mental Illness)
(Brunette et al., *Psychiatric Services*, 2011)
- Cigarette smoking rates in patients with an SMI: 45%–90%
- Cigarette smoking rates in general population: 20%

Diseases caused by smoking
- Lung and other forms of cancers
- Heart and blood vessel diseases
- Stroke
- Cataracts

Quitting smoking in patients with an SMI
(Brunette et al., *Health Education Research*, 2012)
- Difficulty: Not using the traditional resources
- Solution: Using a well-designed program for individuals with an SMI
  - Constant (24 hours a day) monitoring
  - Access to structured computer programs

Motivations
- Patients with SMIs are willing to quit smoking
- No effective therapy/program to help quit and prevent relapse
- Need for a device:
  - To collect important data that helps the user quit smoking
  - To act as a coach to help the user quit smoking

Smoking causes fatal lung cancer

Design Features

- Integration of electronic circuitry into the cigarette case
- Logs access data and sends it to the phone wirelessly via Bluetooth
- Presents the data to the user and health professionals to aid the user in quitting
- Interacts with the user to obtain data about smoking habits
- Accessible to patients with SMIs using instructive text, intuitive navigation, and minimal requirements for abstract thinking and memory
- Operates with an on-board wall-charge Li-ion battery

Block Diagram of the System

Cigarette Case

Microcontroller; Sensor 2 (Number of cigarettes taken); Power; Bluetooth Module; Phone; Subject; Sensor 1 (Case Status Opened/Closed)
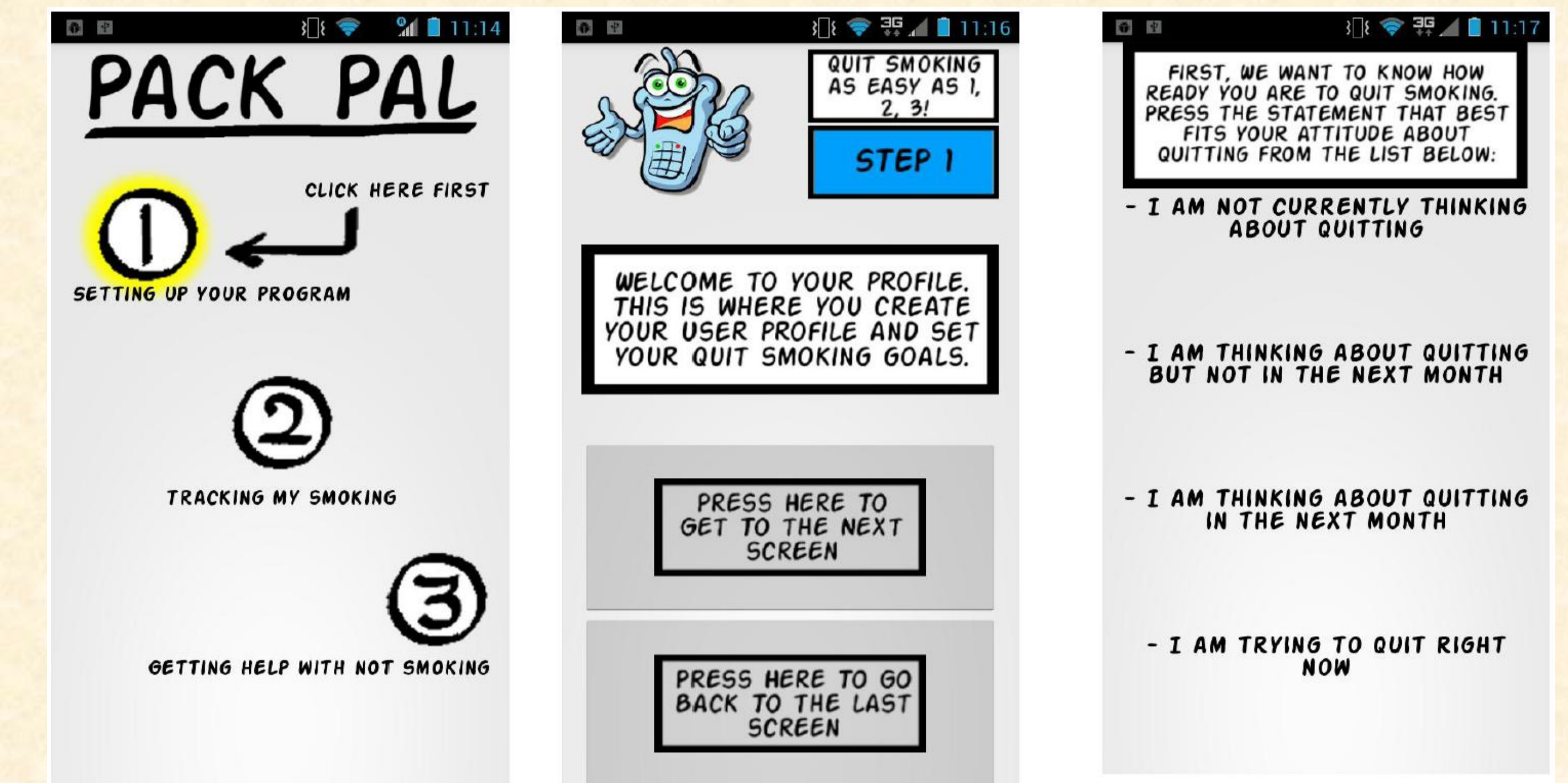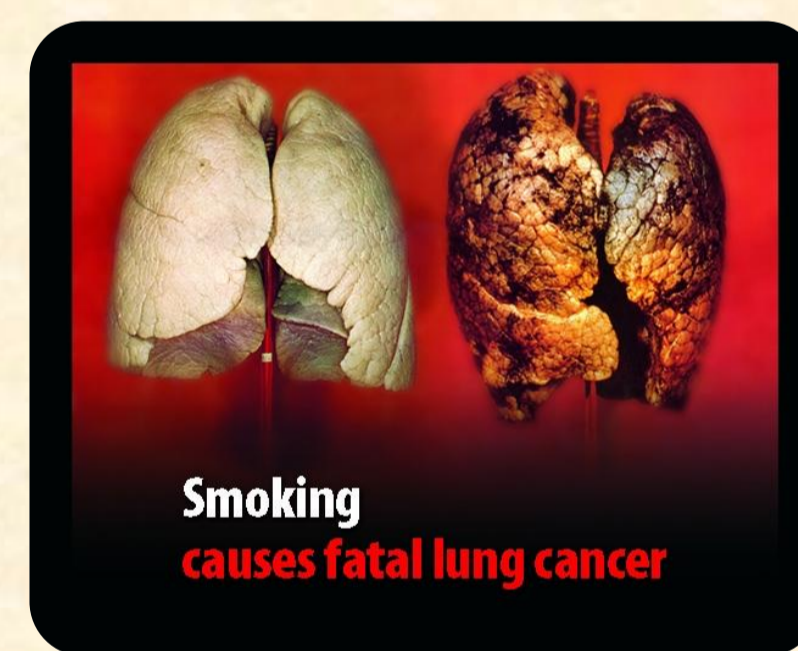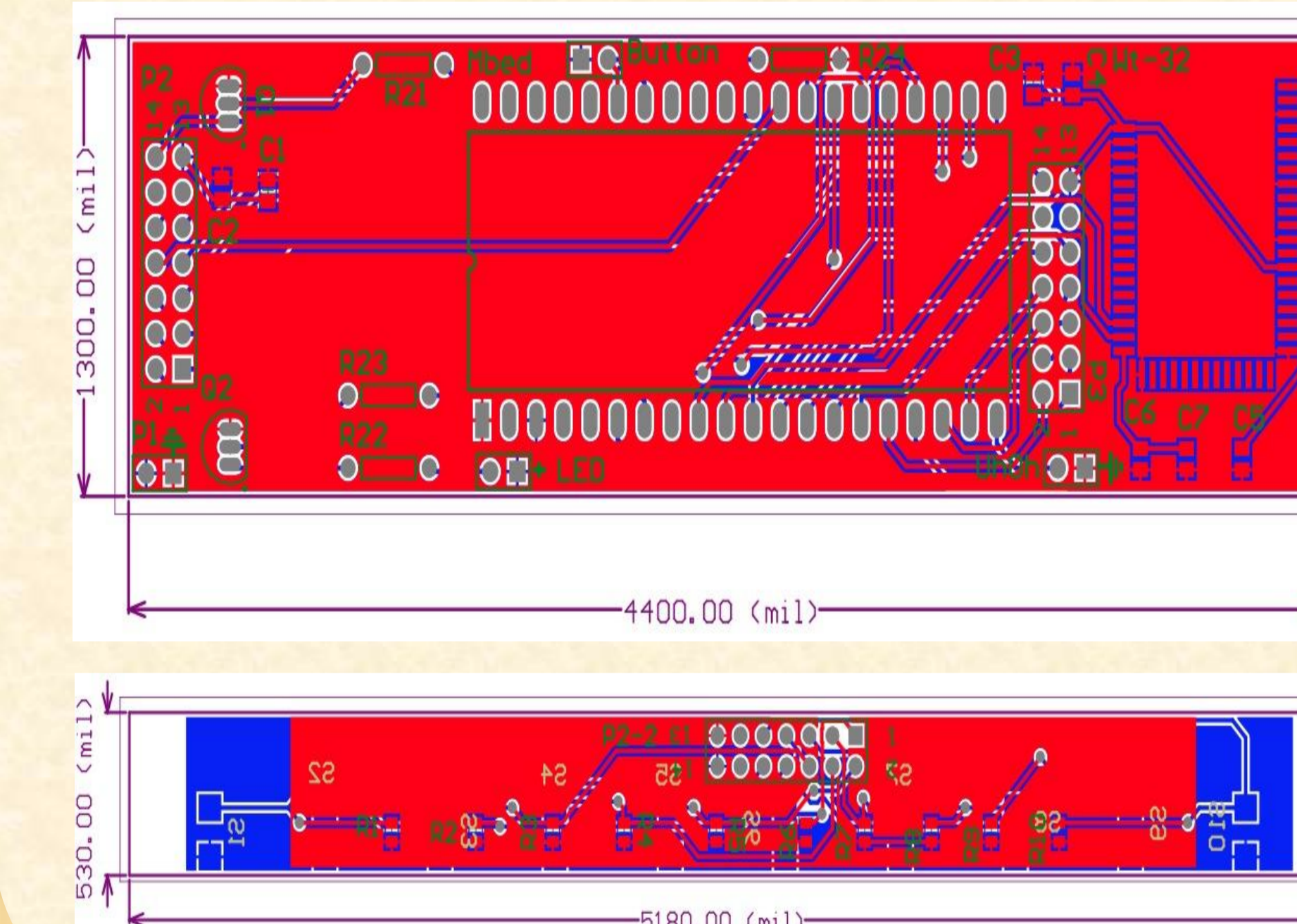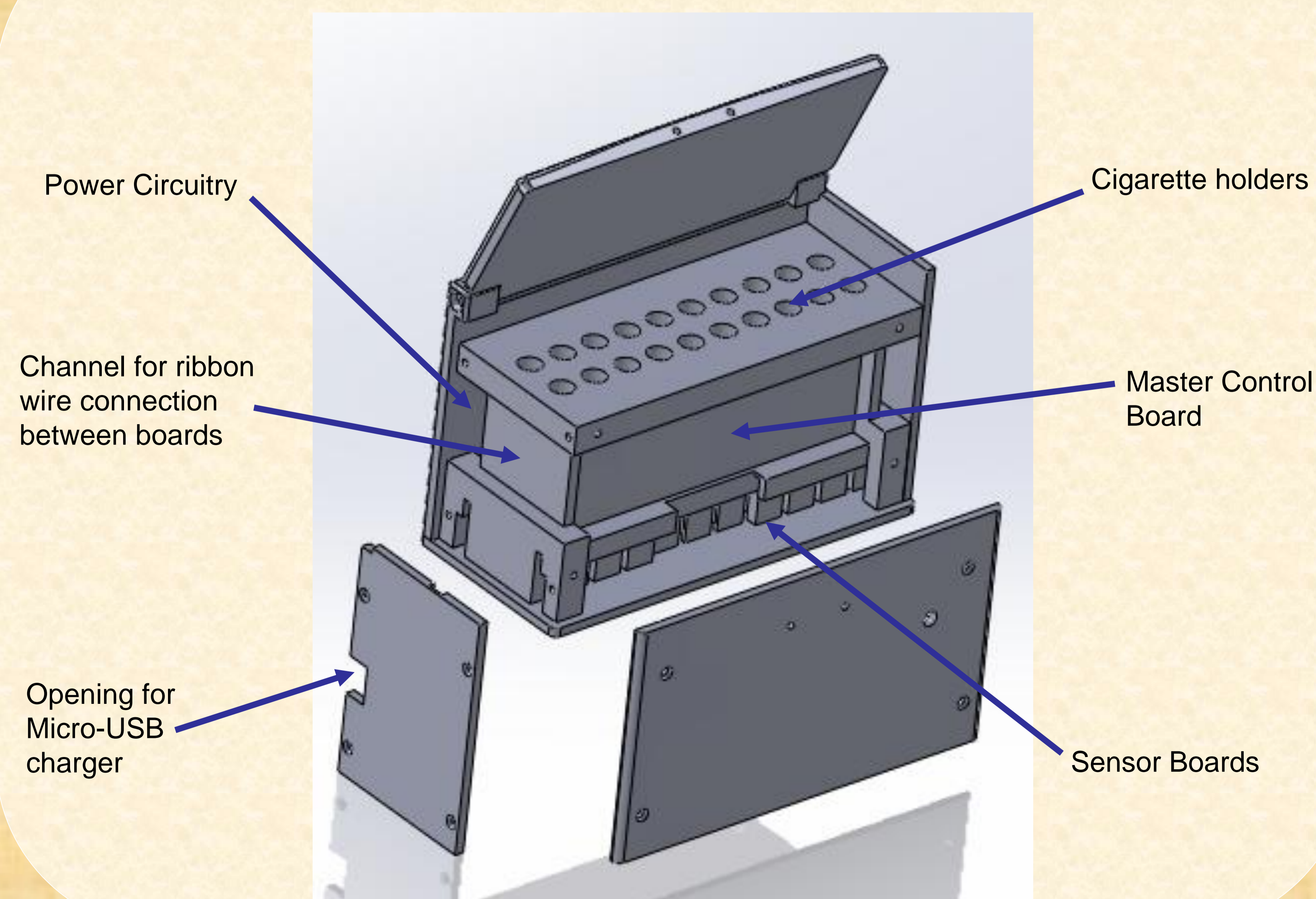
Case Requirements
- Sense access data:
  - Opening
  - Closing
  - Number of cigarettes removed
- Transmit the data to the smartphone wirelessly

Smartphone Requirements
- Analyze the data from the case
- Deploy countermeasures to discourage smoking behavior:
  - Picture of smoke damaged lung
  - Social media
  - Friends or Family
- Send weekly updates to the subject

Cigarette Case Design

- Power Circuitry
- Channel for ribbon wire connection between boards
- Opening for Micro-USB charger
- Cigarette holders
- Master Control Board
- Sensor Boards

Application

- Data, such as environmental triggers and craving strength, is collected
- Healthcare professionals use data to aid in the quitting process
- Android application programmed in Java
- XML based Layouts
- Communicates with case over Bluetooth
- Interacts with the user when the case is accessed to offer alternatives

Printed Circuit Board

Electronics and Boards

- Master Control Board:
  - Mbed Microcontroller
  - Bluetooth communication module
- Power Circuitry:
  - Battery
  - Charging Circuit
- Sensor Boards:
  - Two per case
  - Each holds 10 tactile switch sensors

References

Brunette, M., Ferron, J., Devitt, T., Geiger, P., Martin, W., Pratt, S., Santos, M., and McHugo, G. (2011). Do smoking cessation websites meet the needs of smokers with severe mental illnesses? *Health Education Research* Vol.27 no.2 2012. Retrieved May 20, 2012.

Brunette, M., Ferron, J., McHugo, G., Davis, K., Devitt, T., Wilkness, S., and Drake, R.. (2011). An Electronic Decision Support System to Motivate People With Severe Mental Illnesses to Quit Smoking. *Psychiatric Services, 62*(4), 360-6. Retrieved May 20, 2012, from Psychology Module. (Document ID: 2312884271).

Acknowledgement

For more info: visit https://bmedesign.engr.wisc.edu/websites/project.php?id=487