

# EcoMeal: A Smart Tray for Promoting Healthy Dietary Habits

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## Motivation

- Dietary habit is known to be one of the main contributing factors for obesity, hypertension, and diabetes.
- It is important to manage **what you eat**, but also **how you eat**.

## Research Goal

- Understand the problematic eating behaviors
- Develop an intelligent smart tray that can support patients to maintain healthy dietary behaviors

## Initial Study

- We conducted semi-structured interview with metabolic syndrome patients and their spouses (5 Families; Mean age = 59.3)

### Problematic Dietary Behaviors

- **Fast eating without chewing** (3~10 min max.)  
*"the food slides through the throat after few chews (P3)"*
- **Excessive portion served**  
*"(wife serving full bowl of rice saying) he can take out some of the rice if he wants, but I don't feel right if I serve less"*
- **Following the spouse's eating pace** (non-patient)  
*"I found myself eating at the same pace without any intention (P4)"*

### Dietary Management Strategies, and Difficulties

- **Portion control**  
Using personal tray and personal bowls, BUT *unaware of the right portion or over serving by the spouse*
- **Speed control**  
Using stop watch or clock, mindful of slow eating, BUT even being aware of the time, *not able to control the speed according to the left over portion*

## Prototype Design

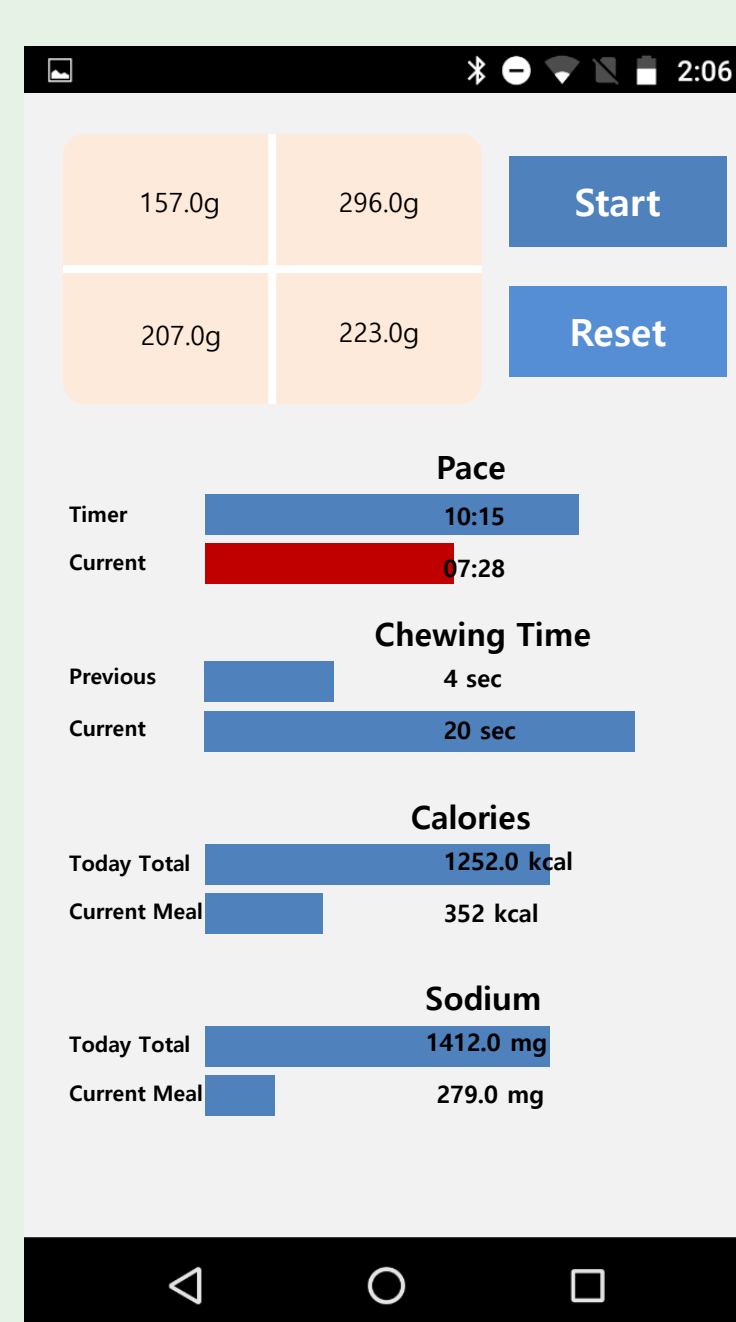
### Smartphone App

#### Setting:

- Input user's physical profile
- Food/dish type selection (Calorie/sodium DB available)

#### Visualizes:

- Food portion
- Eating pace
- Calorie intake
- Sodium intake



### Tray

#### LED indicator

: notifies the user of **over plating** and when the **eating pace** is too fast

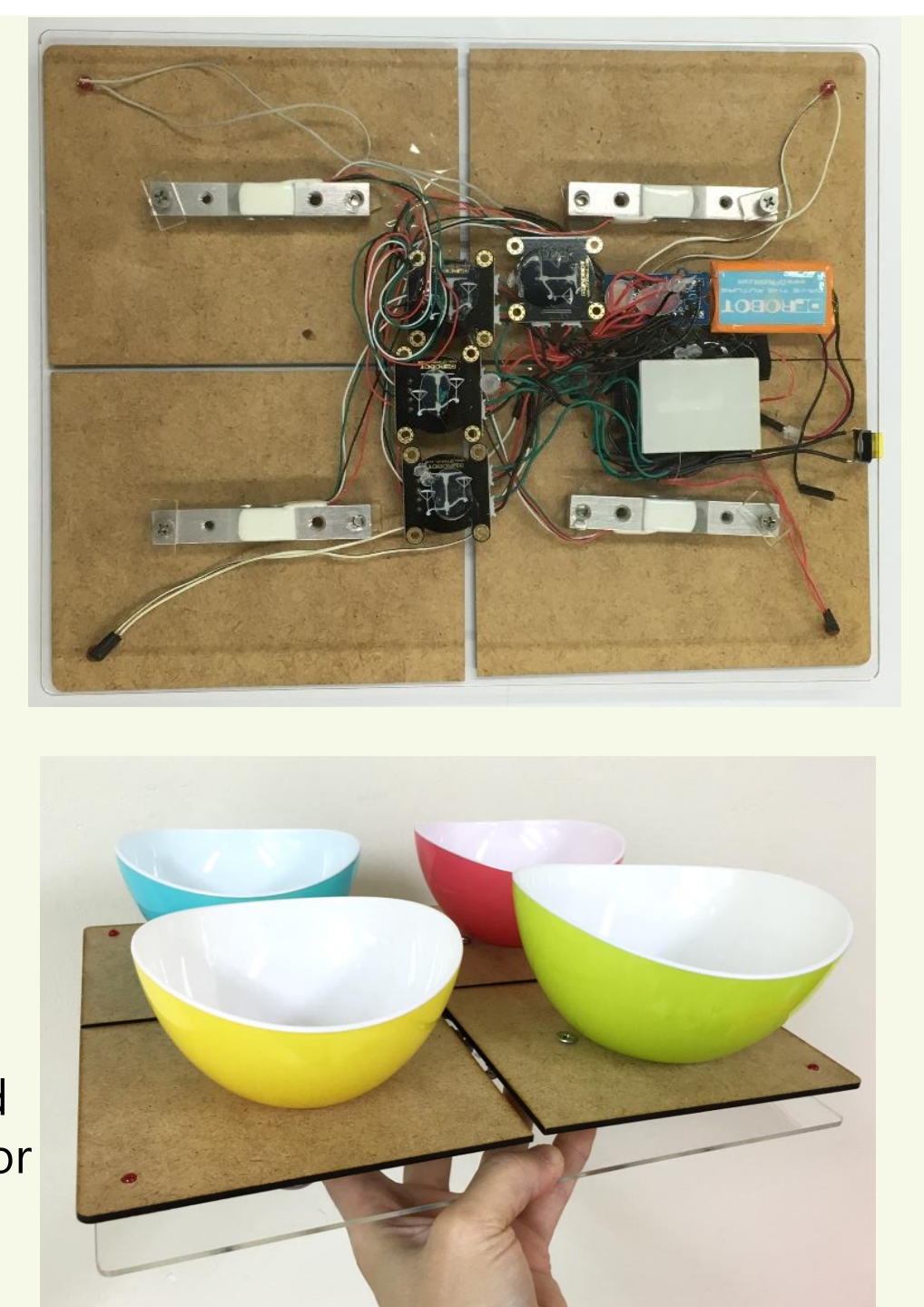
#### Load cell

: **weight sensor** capable of sensing at **gram-level accuracy**

**Divided sections**  
: four **individual sections** for assigning **different types of dishes**

#### Microprocessor

: Bluno Nano and PCB used for processing weight sensor data and communication with the App via Bluetooth

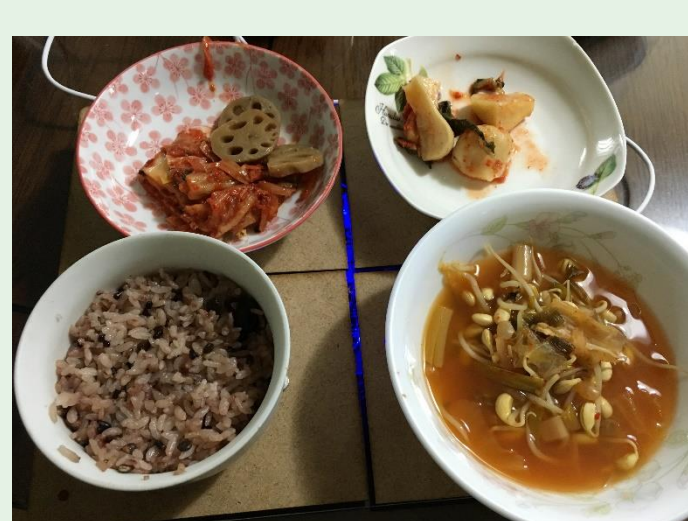


## Evaluation

- We conducted a one day, in-situ experiment with three metabolic syndrome patient families (Mean age = 60.1)

### Food plating process

- **Preventing "over plating"**  
The LED signal acknowledged the recommended portion, leading them to take out some of the rice off the bowl
- **LED indicator as means of relieving from "stress of uncertainty"**  
For those, whom the LED did not blink, said that they were satisfied with the simple LED OFF state, which was perceived as a "confirmation from the device for appropriate food portion", freeing them from the worries of uncertainty
- **Limitation in the number of available tray sections**  
Some dishes were not able to be "on" the tray due to the number of tray section limitation. Users either left them out of the tray or placed more than one dish on one section of the tray



P1 wanted to plate more dishes on the tray, but due to the limited sections, left them out, preferring tracking down each dish accurately.



P3 ignored the food type based calorie tracking, and plated three to four dishes on each tray sections saying that controlling eating pace is enough.

### Eating process

- **Slowed their eating speed**  
Four people (two households) finished after 15 minute goal (avg = 19.5 min) and two (one household) finished earlier (avg = 12.1 min)
- **Some ate faster than usual**  
A negative side effect was the eating pace visualization bar was "ticking-down" style, which was said to increase anxiety to eat within the "time limit"
- **Strong mutual influence of eating speed**  
Even though they were following the smartphone guide of eating pace, watching their spouse eat made themselves to eat at a similar speed.  
*"I did check my pace on the smartphone, but then watching my wife eat made me pace up with her"*



"watching the timer ticking down made me eat faster than usual (P6)"



Eating gesture recognition through weight sensor needs improvement - placing the spoon on the tray or bowl holding gesture led to many temporal false positives