Food Intake Monitoring System to Prevent Obesity

Abstract

Recently the obesity is a major problem all around the world. If people do not prevent the increasing the obesity it will cause the young dead beacuse of the fatness. Obesity is increasing the weight with out any subjective control. It happens with out consciousness of obese people.

In our project we will develop an application to determine the speed of eating. Thus we hope to measure the eating speed. There is a threshold of eating speed about the being an obese or not. In our application we use this threshold value to warn people whether eating speed is much more than threshold value. We decide for warning with peak values of eating speed graphical wave. We apply the Gaussian Smoothing to acceleration data to get real peak values. Thus we warn people to eat slower. Not only warn people to eat slower but also we return a esult if he/she may be an obese. Although we use the real time data , in our application we can use another data packages to determine the obesity situation.

1. Introduction

Food intake monitoring refers to determine being an obese or not. Obesity is a major health problem which is increasing dangerously day by day for last 20 years in the world. There is not any person who borns as an obese. Obesity is coming into being in time. It is establishing with eating fast.

If a person doesn't recognize how does he/she eat (fast or slowly) it means this person is in distress to be an obese. The recent researches show us , we can prevent the obesity with eating normal speed. Already how we can determine what does the normal speed for eating means? To answer this question we have to mention about the threshold value of eating speed. This threshold value can change with some special properties such as gender, age, weight etc. [1] Also if we mention about eating speed we must care about the to be full signals for brain. Some research results show us our brain send to be full signals at least 15-20 minutes later than start the eating. [2]

In this project we use this threshold value to warn people about their eating speed. If he/she eating fast we warn with a message to eat slower. For this project we developped a phone application. There are some other systems which monitoring food intake already. How ever our project is getting easier to figure out the eating speed.

We get the acceleration data with a sensor which is as a wrist band. This sensor take the acceleration data while eating. And send the real time data on instantly to aour phone application with bluetooth interface. So it means there is a bluetooth communication between sensor and our phone. Then we smoothed the real time data with gaussian smoothing method to determine the right peak values. When we have the filtered real time acceleration data our phone application shows us the signal wave. Thus we can see the peak values easily. If the peak values frequency is more over the threshold value our application warn the person.

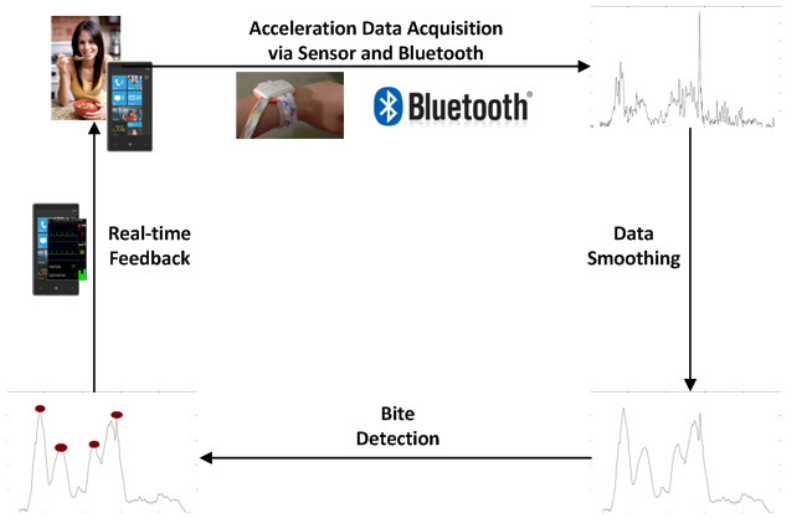


Figure 1: System Architecture

2. *Research Methods*

2.1. Bluetooth Communication Model

In our project's bluetooth communication is between our sensor and phone. Both of then have bluetooth interface module. And we send our sensor's acceleration data to our phone easily.

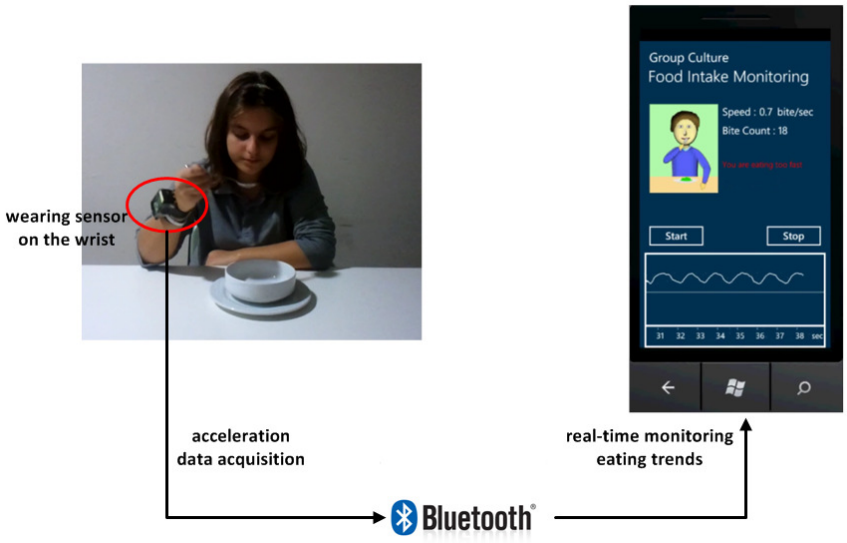
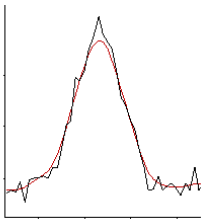


Figure 2 : Bluetooth Communication Model

2.2. Gaussian Smoothing

The Gaussian Smoothing is that is used to smoothing and remove the distortions and noise of a data set. It does not same of mean filter method. It uses a different kernel and some special properties.[3] The formula of Gaussian Smoothing is below.



Cleared and smoothed acceleration data by Gaussian Smoothing

Figure 3 : Gaussian Smoothing Result Sample

$$G(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{x^2}{2\sigma^2}}$$

σ is the standart deviation of distribution.

There is a sample noisy data below. In This data we didnt used Gaussian Smoothing. How ever we didn't satisfied by the result. Because to determine the peak values from this type noisy data set is impossible. Hence we decieded to apply the Gaussian Smoothing to the acceleration data set.

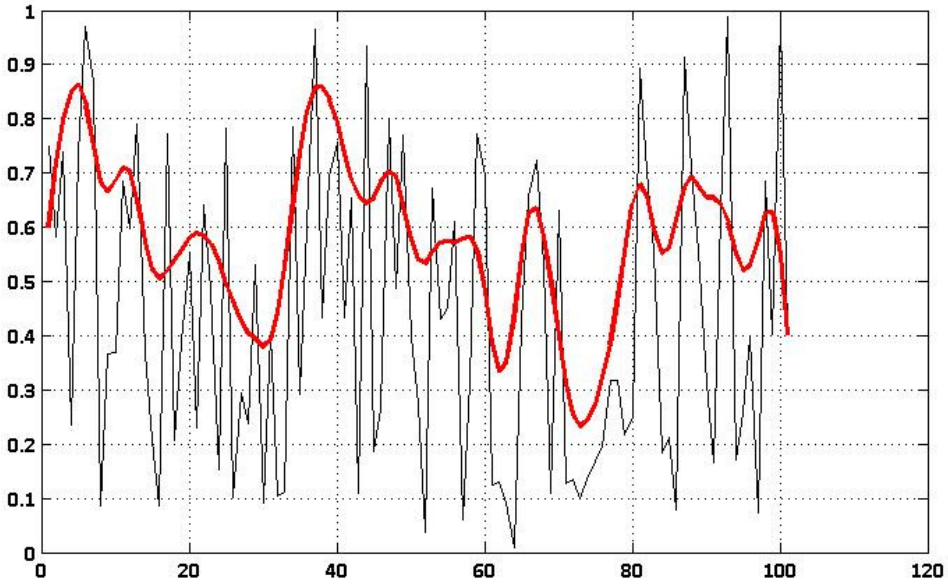


Figure 4 : Specific Smoothing Method Applied Data Result

When we decide the real peak value we use Gaussian Smoothing. Because we had to get the real data of acceleration data. As you guess there were lots of vibration aceleration data too. To remove these type of noises from our data set we applied this smoothing method and we took the actual important data. Thus we had the real peak value.

3. Related Works

There are some methods to monitor food intake activity of users. Dong et al. Used a wired InteriaCube3 sensor produced by InterSense corporation (InterSense, Inc., Bedford, MA) to calculate motion in order to identify bites. Because the sensor data is noisy, it was applied gaussian-weighted window[REFX1] . In paper [REFX2], it was used InteriaCube3 sensor as bite detector, too. A computer software developed by Yujie Dong and Dr. Adam Hoover of Clemson University's Department of Electrical and Computer Enginering to evaluate sensor data. This project is the first mobile application which monitors food intake activity. It both supports to attach mobile device to wrist and to attach three-axis bluetooth supported accelerometer sensor to send motion data to mobile device over bluetooth. So, user can watch own activity during meal.

4. Application

Our application is a phone application. We developped this application with an interface to warn people with a different colored message as an alarm signal. This application takes data from sensor by bluetooth connection namely there is a handshaking between these two device and applies Gaussian Smoothing to data. After that shows a signal wave instantly. At the same time a cartoon character represents the real eating speed as a movie.

When it catch the peak values it starts to watch the speed and compare the threshold value. If th peak values thickness is greater than threashold it shows a message to warn person such as “You eat too fast. Please eat slower!”. This message is colored red cause of warning color.

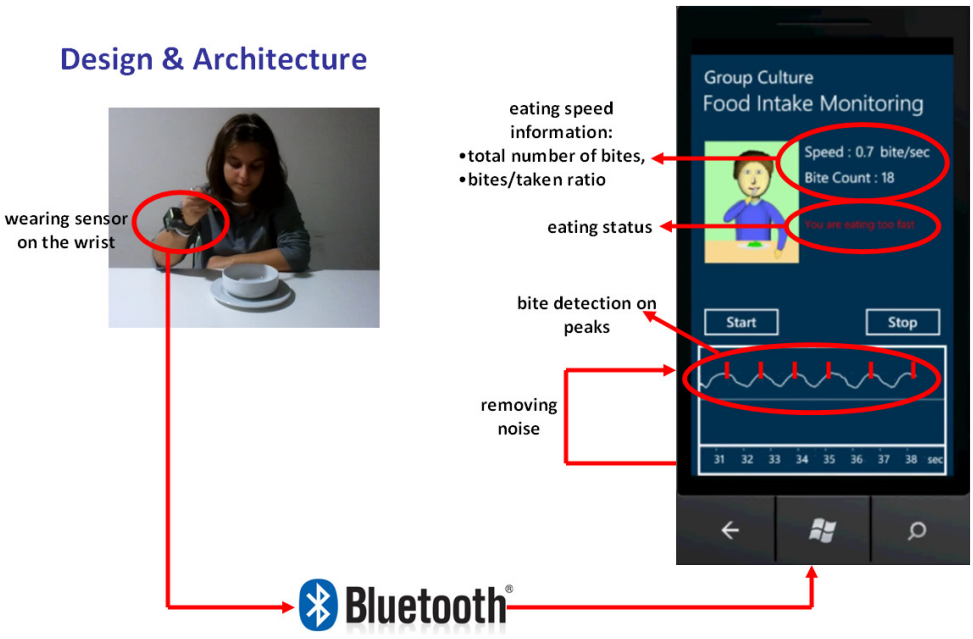


Figure 5 : Application Design Architecture

The illustration of our application is depicted in Figure 5. Our system gets acceleration data from the sensor that user wears on the wrist during a meal. Then, the acceleration data is sent to the Windows Phone via Bluetooth. The output of the sensor is very noisy. Gaussian smoothing filter is applied to the data in order to reduce the effects of noise. By detecting peaks in smoothed acceleration data, the system identifies the bite actions in which one peak represents a bite taken. Real-time feedback is provided to the user regarding eating trends. The system counts the total number of bites the user has taken, and provide the bites-taken rate of the user. Finally, user is provided about his eating speed whether normal or fast. If the user is eating too fast, the system warns him to slow down.

The system provides real-time feedback to the user regarding eating trends such as bites-taken rate and eating speed. The user is warned by the system if he is eating too fast. So that the user is able to control his/her eating speed.

Technologies used include: Microsoft Visual Studio 2010 as programming environment, Microsoft Expression Blend, Microsoft Windows Phone 7, a hand wrist sensor and Bluetooth.

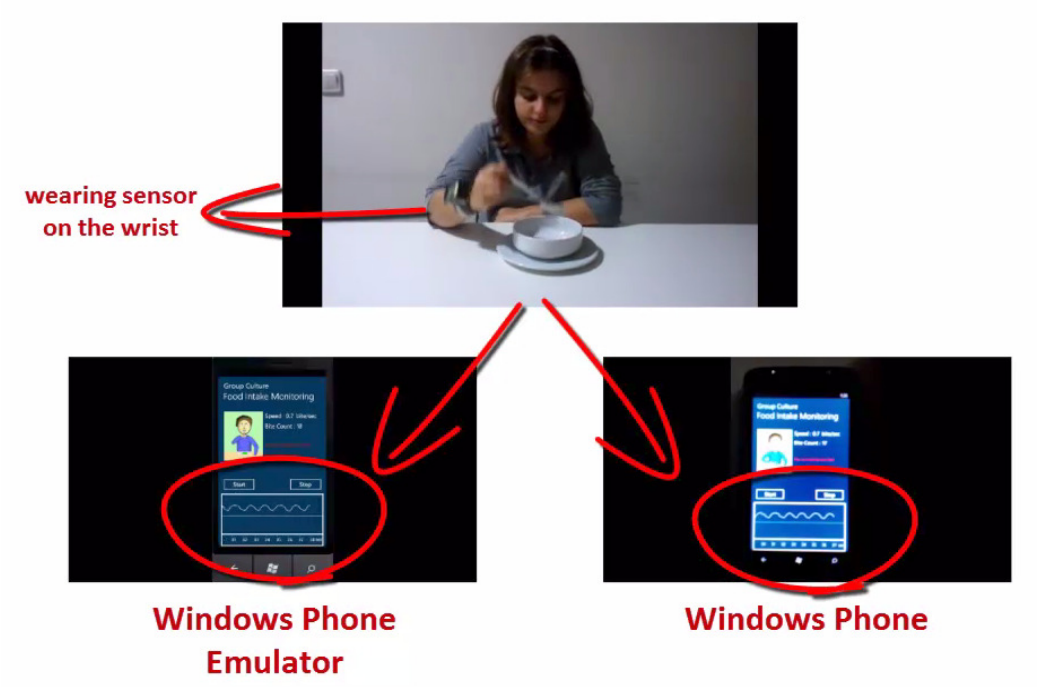


Figure 6: Real-time Feedback regarding Eating Trends

The developed Windows Phone based system to monitor food intake is simple and low cost. Our solution can monitor consumption of food intake during a meal that can help to manage weight loss. The system can help people who are obese to manage their body weight, by providing bite count targets over an extended period of time. It can also be used to help people control eating rate, or to help people with other eating disorders. What makes our application unique is that it can be used in any environment that eating occurs including homes, restaurants, places of business, and other social gathering spots. The system provides real-time feedback to the user regarding eating trends such as bites-taken rate and eating speed (Figure 6). The user is warned by the system if he is eating too fast. So that the user is able to control his eating speed.

We envision that our product will be mobile phone software. It will be installed/deployed to the mobile device.

Our product can find use in a number of applications, including helping a user with obesity, eating disorders or eating rate problems. As we consider 1 billion overweight adults, 17.6 million overweight children under five and at least 300 million obese worldwide [6], millions of people in the world will use our product.

5. Conclusion

We have only 15 experiments with our system for now. There are 7 women and 8 men in our experiment group. And we identified 3 women, 2 men who susceptible to be obese. We think with our project people may be more careful about their eating speed.

As you can guess some times people can not understand their eating speed. If there is an application on their phone they can be warned to eat slower to prevent them selves being an obese.

In briefly, our project and experiment results show us we can prevent the obesity by monitoring food intake in the world with a phone application and a sensor. What makes our application unique is that it can be used in any environment that eating occurs including homes, restaurants, places of business, and other social gathering spots.

6. References

[1] Threshold Values of High-risk Echocardiographic Epicardial Fat Thickness Gianluca Iacobellis, Howard J. Willens, Giuseppe Barbaro and Arya M. Sharma Department of Medicine, Cardiovascular Obesity Research and Management, McMaster University, Hamilton, Ontario, Canada, 2008

[2] http://www.wikihow.com/Eat-Properly #Step 12

[3] http://homepages.inf.ed.ac.uk/rbf/HIPR2/gsmooth.htm

[4] Obesity and Overweight, World Health Organization Global Strategy on Diet, Physical Activity and Health.

[5] D. F. Behan, and S. H. Cox, “Obesity and its Relation to Mortality and Morbidity Costs”, Committee on Life Insurance Research Society of Actuaries, December 2010.

[6] C. L. Ogden, M. D. Carroll, “Prevalence of Overweight, Obesity, and Extreme Obesity among Adults: United States, Trends 1960-1962 through 2007-2008”, M.S.P.H., Division of Health and Nutrition Examination Surveys, June 2010.

[7] Obesity and Overweight, World Health Organization Global Strategy on Diet, Physical Activity and Health.