SPLENDID

Personalised Guide for Eating and Activity Behaviour for the Prevention of Obesity and Eating Disorders

Newsletter 1, September 2014

Welcome

On behalf of the SPLENDID consortium, we welcome all the readers to the first edition of our newsletter. Our team, consisting of a group of expert scientists and engineers from five European countries, develops a personalised guidance system that can monitor and guide young individuals to improve their eating and activity behaviour.

Our motivation is to offer a solution to address two major health problems, obesity and eating disorders such as anorexia and bulimia. Our approach is to adopt successful behavioural treatments currently available in specialised clinics and make them accessible, via wearable technologies, to the general population. We target young individuals and aim to help them learn how to eat and be active so that they maintain a healthy lifestyle and prevent the onset of food related problems.

Through biosensors and specialised algorithms, SPLENDID will monitor key parameters of eating and activity, such as food intake, meals structure, snacking, daily physical activity and offer guidance towards recommended behaviours.

Started in October 2013 and now after one year of hard work we have achieved a lot of exciting results! In this first issue of our newsletter you can read about the chewing sensor prototype and its first use by 23 volunteers. We present the field experiments for activity and meal recording. Additionally you can get an overview of the SPLENDID system and of the smartphone app.

We hope that you will enjoy our press!

Eirini Lekka, Technical Manager

Inside this issue

"Today there is no need to be physically active to obtain food, nor does it cost much to eat. That is the reason why two billion people are overweight or obese"

SEVENTH FRAMEWORK PROGRAMME

Contract number: 610746

SPLENDID system

SPLENDID comprises three main subsystems: i) the sensors, ii) the monitoring and guidance smartphone application and iii) the decision support server.

The Mandometer, a scale measuring the food weight during meals, the Activity Meter, a triaxial accelerometer that will measure the detailed activity level of an individual throughout the day and a chewing sensor, embedded in a standard earphone, that will detect snacking constitute the three sensors.

Their measurements are transmitted via bluetooth to the smartphone where they are further processed. The result is the extraction of behavioral indicators, such as total food intake, food intake rate acceleration/deceleration, average bite size, the number and time of snacking events during the day, the activity level of the individual throughout the day.

At the server-side, the extracted behavioural indicators and user input will be aggregated and subsequently analysed for the purposes of risk assessment and personalised guidance. Risk assessment is equivalent to estimating the probability that an individual will develop obesity or eating disorders. This is based on her/his current status, parametrised by the extracted indicators and personal data (sex, age, and BMI).

The decision support subsystem will also assess the proximity of the individual's behaviour to a set of goals prescribed by a health professional. Based on the evaluated proximity to goals, the system will provide feedback and recommendations to the individuals for adjusting their behaviour as needed. Finally, this subsystem will be equipped with visualization capabilities concerning all the measured and user-reported data as well as the analysis results for easy progress monitoring by both the user and the health supervisor, for this purpose a web-based application is developed.

"The first version of SPLENDID, V1, is expected to be available in November 2014"

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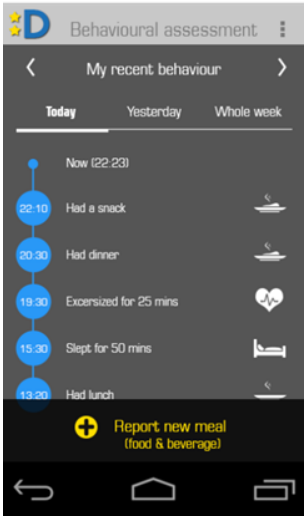
The Smartphone app

The SPLENDID Smartphone application runs on android devices and is responsible for:

i) communicating with the sensors and receiving the collected measurements. ii) signal processing and extraction of behavioural indicators. iii) receiving input from the end-users and providing feedback to them. iv) aggregating the extracted indicators and the user-reported information, and transmitting it to the server for processing.

The AUTH engineers presented and discussed the first designs of the mobile app with dieticians and eating behavior experts during a dedicated workshop in Stockholm, in June 2014. The outcome of the workshop was a set of recommendations to improve the intuitiveness and attractiveness of the user interface in order to optimize the user experience and increase usage compliance.



View of daily recorded activities.

"An app mockup will be evaluated during the first SPLENDID pilots, planned for spring 2015."

Innovative chewing sensor

One of the major innovations of SPLENDID is the development of a sensor which will be capable to detect chewing events. The idea is to provide a discrete wearable sensor for long time use, to detect snacking events through chewing, for different food structures.

The sensor is being developed by CSEM, a private research and development centre based in Switzerland, specializing in micro– and nano technology.

An experimental prototype has already been produced. It consists of two microphone-based acoustic sensors and an optical sensor. A series of measurements have been carried out at CSEM in order to assess whether the signals acquired by the developed sensors are good enough to be used to extract useful information on mastication.

The prototype was delivered in July 2014 to Wageningen University. Mr Lingchuan Zhou , engineer from CSEM trained researchers at WU to use the sensor in order to conduct the first validation study.

The experimental prototype of the chewing sensor consists of two microphone-based acoustic sensors and an optical sensor.

The Restaurant of the Future

The study was conducted in the Restaurant of the Future of Wageningen University and Research Centre, housed in the Futurum facility.

In this controlled environment scientists can observe restaurant guests. Moreover, it houses specialised labs, such as the oral lab where the current study was carried out.

View from outside of the Restaurant of the Future of Wageningen University.

Use of chewing sensor

Placing of EMG electrodes on the skin overlaying the muscles involved in oral processing of food. EMG signals were used as reference

From July 28th to August 15th the first chewing sensor experiment was performed at Wageningen University .

The aim was to test the first prototype consisting of three different eating detection sensors, two acoustic and one optical, in order to investigate how well each one detects eating in real-life. A secondary aim of the study was to get feedback on the wearing comfort of the devices.

In total 10 females and 13 males between 18 and 30 years old participated in a test session. During the session they wore all the three sensors as well as reference sensors, while consuming several foods and performing simple tasks. Electromyography (EMG) has been selected as the reference methodology since it is currently the golden standard for chewing detection.

The foods consumed varied in structure (i.e. liquid, semi-solid and solid) and the tasks consisted of activities that could be mistaken for eating (e.g. talking and coughing). The collected signals together with detailed annotations have now been transferred to AUTH for processing. Their findings will help decide which sensor we should continue developing. The selected sensor will then be optimized for size and comfort.

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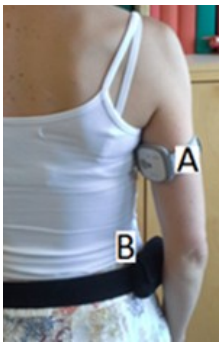
Recording real-life behaviour

The physical activity and the eating behaviour studies started in May 2014 and continued throughout the summer. They were carried out by Karolinska Institutet and AB Mando, with the participation of 15 males and females between 18 and 30 years of age.

The aim of the physical activity study was to compare the first prototype of the SPLENDID activity sensor, developed by the electronic sensor research center CSEM, with a commercial sensor and to collect additional free living data for the extraction of behavioural indicators from real-life measures. The sensors were compared through a set of scripted activities, lasting for 1 hour and 15 additional 24-hour datasets were collected with the commercial sensor.



On the left: Placement of the accelerometers A) the commercially and B) the SPLENDID sensor. On the right: The Mandometer and two of the dishes that were served, hamburgers and soup.

The primary objective of the eating behaviour study was to provide data on the sensitivity and to determine the limitations of the Mandometer® sensor. The Mandometer® is a scale connected to a control unit. The sensor describes in real-time the progression of a meal and offers feedback to help control the size of the meals by normalising the way of eating. In order to study this, a wide variety of foods, ranging from soup to hamburgers, were served while using the Mandometer®. The collected signals are currently analyzed by AUTH and their findings will help identify different food types eaten at the Mandometer®.

SPLENDID @ school

One of the intended uses of the SPLENDID system is to be used as a combined screening and prevention programme at schools in order to screen adolescents during their school meals and identify those at risk of developing eating disorders or obesity. The first version will be tested by approximately 40 high school students in spring 2015 at IEGS Sweden (Internationella Engelska Gymnasiet Södermalm, Sweden).

The school buffet area at IEGS that will be used during the V1 evaluation.

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SPLENDID will be presented at the Mobihealth conference in November 2014, in Athens

http://mobihealth.name/2014/show/

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