Objective and Subjective Meal Registration via a Smartphone Application

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ABSTRACT

The **SPLENDID** research programme develops a new preventive intervention for young people at risk for obesity and eating disorders. In this effort, the **SPLENDID app** is a novel smartphone application that mediates the monitoring & modification of the participants' **eating & physical activity behaviors**; the app receives and manages eating & activity related signals from three communicating sensors as well as subjective user input. This work presents 2 discrete **meal registration mechanisms** implemented for the SPLENDID app, along with the relevant **user feedback**.

BACKGROUND

SPLENDID develops an ICT system for delivering a **novel lifestyle intervention** for the **prevention of obesity and eating disorders (ED)** on young populations [1,2]. The **SPLENDID system** [see Fig. to the right] will **monitor** the users' eating & activity behavior by integrating objective recordings from 3 wearable sensors and subjective user input so as to assess the users' risk for obesity or ED. For those at risk, SPLENDID attempts to **modify** their hazardous habits with the help of personalized goals and performance feedback. In SPLENDID system's heart, the SPLENDID app is responsible for (1) collecting recordings from the communicating sensors, (2) providing a UI for subjective input collection and feedback provision, and (3) communicating with the Decision Support Server. This work presents SPLENDID's **novel meal ICT-enabled approach for meal registration via the SPLENDID app** [see left column].
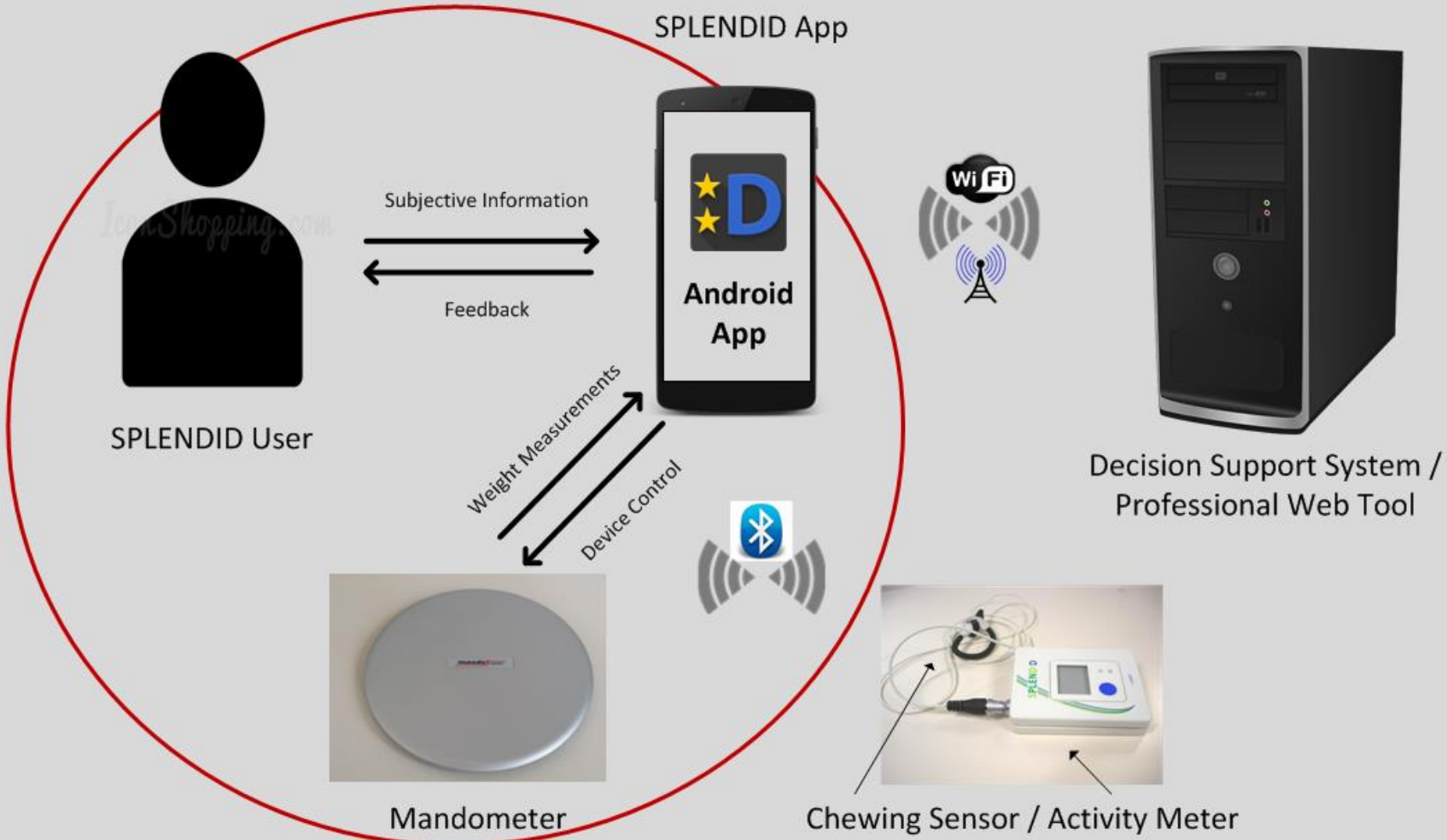
OJECTIVE MEAL REGISTRATION

The primary meal registration mechanism of SPLENDID relies on objective meal recording using the **MANDOMETER** – a Bluetooth enabled food weight scale. The SPLENDID app is able to drive the MANDOMETER to request, receive and store food weight measurements at 1Hz frequency. The meal recording functionality is delivered through a modern, clean and informative UI that requests also subjective meal information from the user (e.g., the recurring "Rate your hunger" question). The recorded **food weight time-series** combined with the subjective input comprise the main input for the advanced computational algorithms of SPLENDID's DSS.

SUBJECTIVE MEAL REGISTRATION

The back-up meal registration mechanism relies exclusively on **user provided subjective information** to fill in for the sensor-based recording approach when objective recording is not possible. Only basic meal information is subjectively completed by the user. This functionality reuses some of the meal recording screens and introduces other similar screens.

USER FEEDBACK

The provision of up-to-date feedback helps users' **recollection**. SPLENID app's feedback concerns both user provided and sensor acquired information and it is delivered in an ambient manner via the **SPLENDID timeline** (i.e., a visual log of events of interest) in the main screen of the app. Presented pieces of information include the occurrence & type of consumed meals as well as the duration & intensity of the user's physical activity. The timeline is updated in real time.

USABILITY EVALUATION

The subjective meal registration and user feedback functionalities have undergone preliminary evaluation by **40 high-school students** in Stockholm (Sweden) on March and April 2015. The students formed groups of 4 and used the SPLENDID app to report a specific meal and then observe the updated timeline; then, they completed an **enhanced version of SUS** [2]. The results indicate that the usability of the SPLENDID app is above average [3] with respect to the evaluated functionalities.

SUS Questionnaire (10 Qs) ✚

Order	Statement
11	I had to do more things than needed while using the app
12	It was easy to enter information in the app
13	The app had too many screens for what it does

		Males	Females	All
SUS	Mean	73.62	68.21	70.78
	STD	8.77	14.14	12.06
Enhanced SUS	Mean	74.58	69.42	72.29
	STD	9.20	11.94	11.31
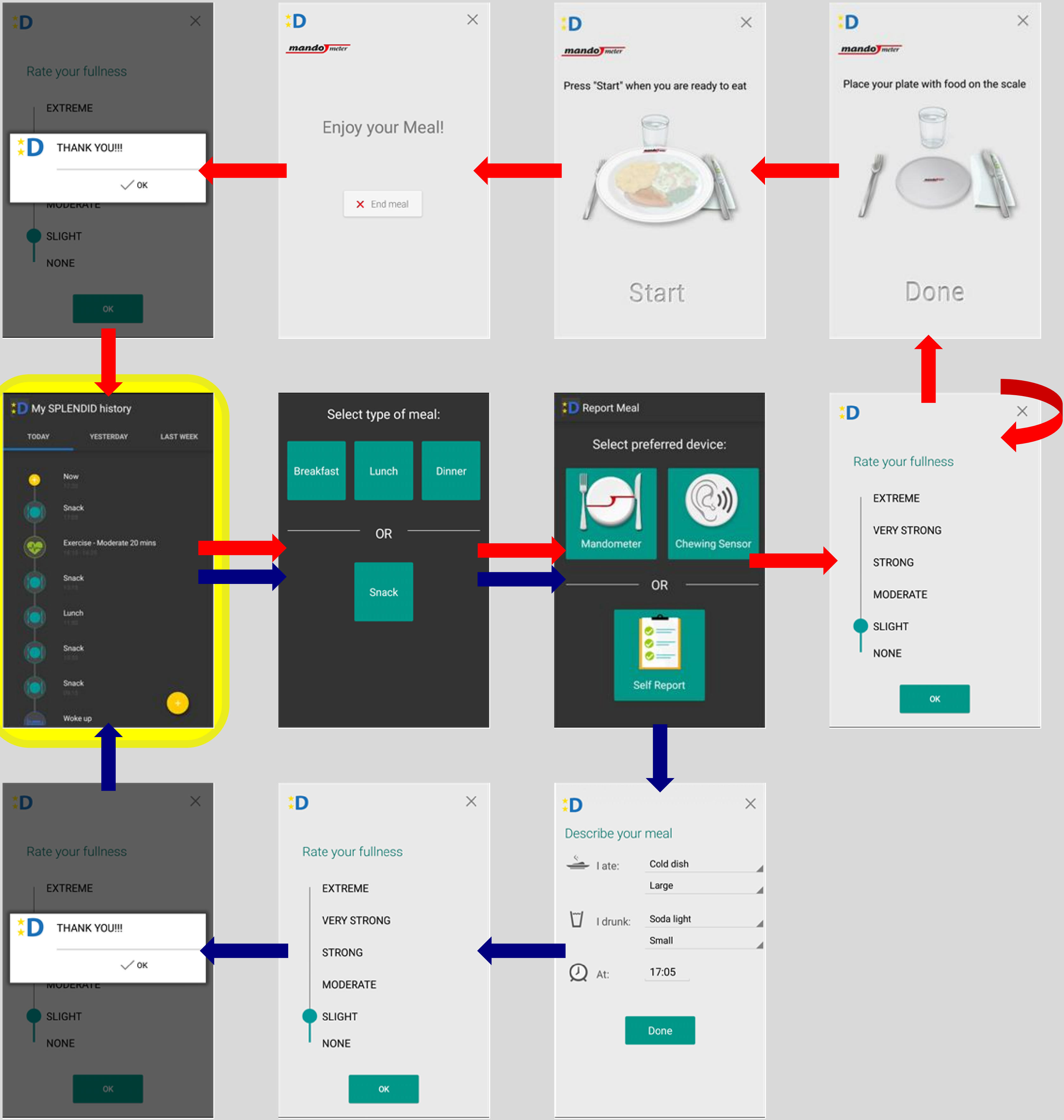
NEXT STEPS

The next step is to exploit the **Chewing Sensor** as a meal recording alternative; this is a currently developed ear plugged device with an open air microphone and a PPG sensor able to capture audio & optical time-series associated with chewing activity. Another feature to be included is the acquisition of **meal photographs** by the smartphone camera for visual annotation of the meal. Once fully developed, the app needs to be further evaluated for both its usability and efficiency in monitoring & modifying the users' behavior.

REFERENCES

[1] Maramis et al. (2014). Preventing obesity and eating disorders through behavioural modifications: The SPLENDID vision. In Proc. EAI 4th International Conference on Wireless Mobile Communication (MOBIHEALTH 2014), pp 7-10.
[2] SPLENDID Programme at http://splendid-program.eu/
[3] Brooke (1996). SUS-A quick and dirty usability scale. Usability evaluation in industry, 189(194), pp 4-7.
[4] Bangor et al. (2009). Determining what individual SUS scores mean: Adding an adjective rating scale. Journal of usability studies,4(3), pp 114-123.