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# Eliciting Values through Wearable Expression in Weight Loss

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## **Abstract**

This paper presents the work-in-progress prototype of i-Ribbon—a wearable device designed to elicit values in the context of weight loss. Starting with an Obesity Awareness Ribbon, we introduced the i-Ribbon concept. For prototyping, we built a system that could extract user's personal health-related data through a mobile application and sent it to a wearable device. The functional prototype enabled us to implement different interaction strategies to elicit corresponding values. Base on the reflection on design and prototyping process, possibilities of future research were identified.

## **Author Keywords**

Social Interaction; Social Expression; Values; Values Elicitation; Wearable; Weigh Loss

## **ACM Classification Keywords**

H.4.m. [Information Systems Application]: Miscellaneous; H.5.2 [Information Systems Applications]: User Interfaces – *user-centered design*

## **Introduction**

Wearable technology is wildly used in the field of sports and weight management. With the development of sensing technology, more and more details about physical activity could be detected and fed back to users. Companies like Fitbit, Nike and Garmin provide a

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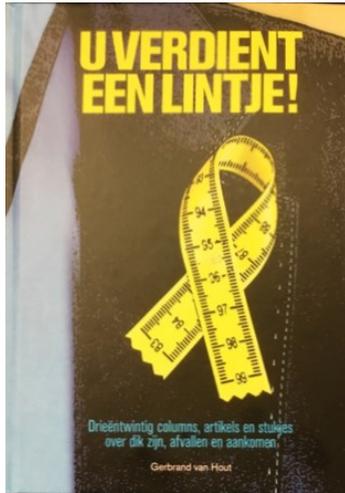


Figure 1: The book of Gerbrand van Hout, entitled "U Verdient een Lintje!" (in Dutch) which means "You deserve a ribbon!" The cover of the book shows the physical version of the Obesity Awareness Ribbon.

wide variety of wearable products to meet users' requirement in different scenarios. The starting point of this research—the Obesity Awareness Ribbon (Figure 1) inspired us about the social attributes of wearable device. Therefore, instead of staring at the increasing sensing capabilities, we focus on the social aspect of wearable device.

From a technical point of view, many wearable devices can be described as a set of sensors and other electronic component which can be worn by people. However, it also could be seen as apparel enhanced by the integration of digital technology. From this perspective, wearable devices could have properties similar to conventional apparel, reflecting wearer's identity, taste, attitude and values. Additionally, with the help of digital and information technology, the meaning that wearable device can present is much richer than conventional apparel.

In this paper, we try to explore the relationship between wearable devices, social expression and human values in the context of weight loss. We present the work-in-progress prototype i-Ribbon, a wearable device designed to elicit values through representing wearer's physical activity data. The prototype presented in this paper was designed based on the results and reflection of a previous iteration [21]. Different from the existing tracking devices, i-Ribbon is designed as a wearable channel for social expression rather than a self-tracking terminal. With the working prototype, we are able to implement different design strategies and evaluate their effectiveness in eliciting specific values in weight loss.

## Related work

### *Wearable Expression*

A number of prior research explored the social aspect of wearable device. Fajardo et al. [3] proposed a contextual wearable display model to describe the typical relationships between display devices, wearers, onlookers and the context, the model was subsequently used to evaluate a pilot study that compared the abstract and overt visualization of skin conductivity on a wearable display device. Some other research also considered the relationship between the wearer of a wearable device and people in proximity [4] [13].

Moere & Hoinkis [12] proposed a wearable folding display that is able to convey wears' behavioural typology. The concept was defined as "an electronically enhanced form of self-expression for increased social awareness in physical reality".

### *Human Values and Values in Weight Loss*

Human values has attracted a lot of attention in psychology and Human-Computer Interaction (HCI) research [9]. The Values Theory proposed by Schwartz [18] defines values as "desirable, trans-situational goals, varying in importance, that serves as guiding principles in people's lives." Kujala & Väänänen-Vainio-Mattila [10] reviewed theories and approach about values in psychology, marketing and HCI; a category framework of user values was proposed to make related concepts more concrete and easier to identify.

Values and the Values Theory have been used in a variety of research related to weight loss. Schwartz & Inbar-Saban [17] investigated the impact of value self-confrontation method on weight loss. The influence of values on exercise and diet has also been explored [2].



Figure 2: Two examples of the prototypes made for initial exploration [21].



Figure 3: Non-functional mock-up of i-Ribbon made for the early iteration [21].

Anshel et al. [1] proposed the disconnected values model (DVM) as an approach for exercise behavior change. The model contrasts people's negative habits with their deeply held values and tries to make a disconnection between them. Kujala & Nurkka [11] provided a sentence completion tool to identify user values and implemented it in the design of an activating game for children.

#### *Values Elicitation*

Ross [16] investigated the possibility of eliciting certain values through aesthetic interaction with lamps. Other methods such as value sketch, value scenarios [20], value probe [5] and photo elicitation [15] have also been used to elicit values. Van de Poel & Kroes [14] investigated whether technical artifacts can embody values, and introduced three different values involved in a design process, including intended value, embodied value and realized value.

### **Design of i-Ribbon**

#### *Starting Point and Previous Research*

The starting point of this research is the Obesity Awareness Ribbon designed by Dr. Gerbrand van Hout and presented in his book [7] (Figure 1) and an article [8]. Similar to the pink ribbon design for breast cancer awareness [6], this ribbon is designed for everyone "who wants to show awareness for obesity and wants to hearten obese people" [8]. The physical version of the ribbon was given to the patients and staffs in the Obesity Centre of Catharina Hospital in Eindhoven. Starting with the concept of the original Obesity Awareness Ribbon, an initial exploration and an early iteration have been conducted. In the initial exploration, we tried to enhance the expressive feature of the ribbon by integrating digital technology. In order

to explore the potential usage scenarios of this digitalized Obesity Awareness Ribbon, several low fidelity prototypes with different expression features were made (figure 2). With the help of these prototypes, evaluation through interview was carried out, two persons with weight loss experience participated and provided some inspirational feedback. The most significant finding from the initial exploration was that the users would like to show their weight-loss efforts through the digitalized ribbon in more expressive ways.

Based on the result of the initial exploration, we refined the concept of the digitalized Obesity Awareness Ribbon and conducted a new iteration. The early version of i-Ribbon was proposed and designed as a wrist-worn wearable device that expressed the wearer's weight-loss efforts. The concept consisted of a wearable hardware that represent wearer's physical activity level through dynamic patterns with mobile application providing an additional interface. The prototype made for the early concept of i-Ribbon consisted of two complementary parts, including a set of non-functional mock-up of i-Ribbon's (Figure 3), and a screen-based simulation of the dynamic pattern. In order to evaluate the concept, a semi-structured interviews with three participants with weight loss experience were conducted. Through the design, evaluation and reflection process of the early iteration, we got better understanding of wearable expression and its potential for supporting weight-loss efforts. Several insights about design improvements and further research directions were identified [21].

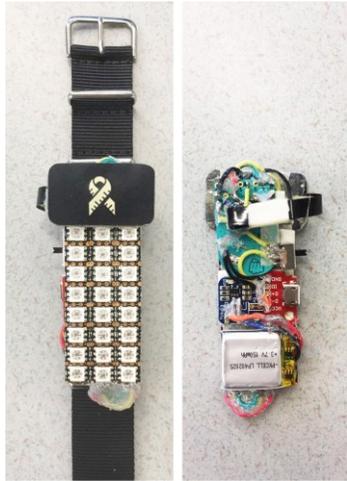


Figure 4: Two sides of the work-in-progress functional prototype of i-Ribbon's wrist-worn part.



Figure 5: Two examples of the representation of wearer's health-related data through the RGB LED matrix on an i-Ribbon.

#### *Development of the current i-Ribbon Concept*

From the last iteration, we realized that the original Obesity Awareness Ribbon was essentially a symbol. And due to the short history of the symbol [7], it has not been widely spread and recognized. Compared to the famous Pink Ribbon [6], the values conveyed by the Obesity Awareness Ribbon is relatively obscure for its wearer. Participants of the last iteration also showed their concern about the values they were expressing when wearing i-Ribbon [21].

Therefore, in this iteration, we try to figure out the relationship among the original Obesity Awareness Ribbon, i-Ribbon and the values it conveyed. We conducted further literature review about human values and values elicitation. Existing research shows that values could be integrated into technology through design [14] and could be elicited through variety of ways [5][15] [16][20]. With deeper understanding of value theory [19] and its relationship with system and product [10], we found that the first iteration could be summarized as an attempt to elicit the value of "supporting weight-loss efforts" by "representing wearer physical activity data through a wearable expressive device (i-Ribbon)".

Based on the above research, we refined the concept of i-Ribbon and defined it as a wearable expression device that eliciting specific values in the context of weight loss. Different expression strategies could be implemented in further research to elicit corresponding values. Through wearing and interacting with i-Ribbon, wearer may have better understanding of the values that symbolized by the Obesity Awareness Ribbon.

#### *Prototype*

The working prototype of i-Ribbon includes a wrist-worn device as medium of social expression (figure 4), and a mobile application connected to Google Fit platform to access user's physical activity data (figure 7).

The core function of the wrist-worn device was implemented through LightBlue Bean with a RGB LED matrix. With the built-in Bluetooth LE module on LightBlue Bean, the device can receive wearer's health-related data from the mobile application and represent through the RGB LED matrix (figure 5). In addition, a button with the abstract version of the Obesity Awareness Ribbon (figure 6) was assembled into the device as a button. Wear could turn on/off the display by pressing this button. The display will automatically turn off after ten seconds if there is no other operation. Wearer's interaction with the button could strengthen the connection between the symbol of Obesity Awareness Ribbon and the values we expect to elicit through i-Ribbon. Other electronic components such as lithium battery, charging module and main switch were also included in the wrist-worn part of the prototype.

In addition to the hardware of wearable device, we developed an Android mobile application to access user's physical activity data and provide an extended user interface. With the Google Fit API, the application can extract data from any device connected to the same Google Fit account, and send it to the wrist-worn device through smartphone's built-in Bluetooth LE module. This feature technically separated the expression and sensing function of the prototype, and brought the possibility of getting data beyond the wrist-worn sensing device. Although we only used the



Figure 6: Abstract version of the Obesity Awareness Ribbon.



Figure 7: Screenshot of the Android mobile application for i-Ribbon's functional prototype.

smartphone's built-in accelerometer and Xiaomi Mi Band as data source at this stage. Data from any other device that compatible with Google Fit platform could be used in further research. The main interface of the mobile application consists of two parts: (1) a pie chart showing user's calorie consumption of walking, running and biking, and (2) a "WEAR IT" button enabling user to convert the data into the visual pattern and display on the wrist-worn device (Figure 7).

### Conclusion and Future Work

In this paper, we presented the development of i-Ribbon concept and its work-in-progress prototype. Based on the result of previous research, we designed a system that could represent wearer's physical activity data on wearable device to elicit wearer's values in weight loss. Through the design and prototyping of i-Ribbon, we identified several options of future work.

#### Refine the Prototype

In order to refine the appearance of the prototype, a 3D-printed casing should be made to wrap the electronic components. The casing should also be designed to shape the lighting effects of the RGB LED matrix in an aesthetically pleasing way.

#### Identify Specific Values

Specific values which will be elicited in future research need to be identified and embodied into our prototype. Method of identifying values in different context has been investigated in existing research [5][11]. In future research, we should identify values that not only have positive affect on weight loss, but also are suitable for the form of wearable device. Values related to the original Obesity Awareness Ribbon could be identified from Van Hout's book (Figure 1) [7] (This

book has been translated into English but has not been published yet).

#### Clarify the Representation Strategies

With specific values identified, we should clarify the representation strategies of wearer's physical activity data to embody the values into our wearable device. In the concept of first iteration, the dynamic pattern simply expanding with the increasing of wearer's steps data. As the system we built for this prototype is relatively flexible and open, different data sources and representation strategies could be implemented. With more specific values to be elicited, appropriate strategies should also be clarified in future research.

#### Evaluation

With refined prototypes, specific values and clear representation strategies, a formal evaluation should be conducted to evaluate the effectiveness of the prototype in eliciting certain values.

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