sense.me: A EUD Environment for Social Products

Alessandro Acerbis, Daniela Fogli
Dipartimento di Ingegneria dell'Informazione
Università degli Studi di Brescia
Via Branze 38, Brescia, Italy
+39 030 3715 666
alessandro.acerbis@gmail.com,
daniela.fogli@unibs.it

Elisa Giaccardi
Department of Industrial Design
Delft University of Technology
Landbergstraat 15, Delft, The Netherlands
+31 015 278 9223
e.giaccardi@tudelft.nl

ABSTRACT

This paper describes a framework that supports the physical prototyping of innovative interactive artifacts. Specifically, the framework allows designing, implementing, and testing "social products," that is, physical artifacts able to interact with social media platforms such as Facebook, Twitter, Google+ and others. Since the target users of the framework are not expert in software programming, an End-User Development (EUD) approach has been adopted, which aims at facilitating the ideation process and providing simple mechanisms for automatic code generation and testing. User tests have proved the usefulness and validity of the framework, and provided indications for how to expand it.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation (e.g., HCI)**]: User Interfaces – *graphical user interfaces (GUI), prototyping, user-centered design.*

General Terms

Design, Human Factors, Languages.

Keywords

Arduino, Internet of Things, physical prototyping, social networks, social media, social products.

1. INTRODUCTION

Enhancing the design process with new frameworks and toolkits for physical prototyping has become a central issue in the education of industrial designers [[3]]. With growing interest in the Internet of Things and the development of objects connected to the Internet [[8]], an additional issue for industrial design education has become how to ease the design process of physical prototypes that link to social data and claim an influence on a digital network. This is a growing design space in which a variety of interactions between physical objects, users, and social networks may be explored and created. In particular, a broad spectrum of *social products* is emerging within such design space. Social products are physical objects able to interact with social

media platforms in two directions: from objects to social media, and from social media to objects. For example a social product may publish on Facebook, as a result of specific actions performed by the user on the physical object; or, it can move and play a sound, to physically manifest what is happening in a user's digital life [[7]].

In this paper, we focus on physical prototyping of social products able to interact with social networks in the first direction. To this end, we have built a framework, called *sense.me*, to support the creation of Arduino-based products [[1]] able to connect to the Facebook API (Application Programming Interface). Since the use of Arduino requires some programing skills, a variety of visual programming environments have been proposed over the years (e.g., ArduBlock, Modkit, and S4A), including toolkits specifically designed for the Internet of Things [[2]][[4]] and tools that empower designers to connect Arduino to a variety of web APIs [[7]][[9]].

However, most of these software environments pay more attention to facilitating code generation rather than to support the ideation process of original physical objects. The end-user development (EUD) research field [[5]] offers methods that open up a new perspective on the prototyping of social products. By leaving low-level programming details to the system, EUD is a suitable approach to sustain the ideation process and foster designers' creativity. Actually, the prototyping of physical objects requires that design ideas are made concrete and tested easily and quickly; this in turn asks for a EUD environment [[6]] that is built around the variety of features that physical objects may exhibit. The approach proposed in this paper tries to satisfy this need by presenting a new web-based framework for the physical prototyping of social products.

In this environment, end users can find features necessary to ideate their social products, obtain the corresponding code to be uploaded on the physical objects, and test social products behavior. The system has been developed along a 5-months period at Delft University of Technology and progressively acquiring knowledge about interaction design activities and students' skills and capabilities. Continuous feedback from students and teachers allowed developing iteratively the system and tune it to the community of target users.

2. THE FRAMEWORK SENSE.ME

The framework *sense.me* drives its users (industrial design students) throughout the physical prototyping activity, by asking them to select and configure social behaviors, physical sensors and input events determined by user gestures on the sensors. More specifically, it includes three sections that correspond to the three different phases necessary to carry out the development of a social product: design, implementation, and test.

In the design phase, the user must begin with the creation of a virtual prototype in *sense.me*; this is achieved by defining a name for the prototype and a set of events. Then, each defined event can be associated with one or more social behaviors. At the moment, the social behaviors available in *sense.me* are related to the user page in Facebook and include: i) content publication on the diary; ii) filtering and visualization of photos extracted from the profile; iii) filtering and visualization of posts extracted from the profile. Each social behavior may require additional information: in particular, for content publication the text to be published must be inserted, whilst for filtering posts and photos, tags must be provided.

In the second phase, each defined event must be associated to a sensor embedded in the physical prototype. In this way, the event may actually become the trigger for the associated social behaviors. The sensors available in *sense.me* are analogue sensors (photo resistor, pressure sensor, temperature sensor, linear potentiometer, and rotary potentiometer) and digital switches (tilt sensor, button, and touch sensor). Each sensor must be configured by inserting information such as the Arduino pin number and the values triggering the event (e.g., threshold values for analogue sensors). After the association of sensors to the events, the Arduino code can be automatically generated and uploaded on the micro-controller.

The third phase consists of testing the behavior of the physical prototype. To this end, the user must provide her/his Facebook credentials and connect the physical prototype with the PC where an application managing the communication between the prototype and *sense.me* is running. In this way, the user can physically interact with the prototype by triggering the events defined in *sense.me* and observe the corresponding social activities performed by the prototype in the system page devoted to testing or directly on the user's Facebook page.

3. USER TESTS

sense.me has been evaluated with the participation of eight students in industrial design. An "ideation workshop" was carried out to test our research hypothesis, namely providing a EUD environment that can easily and effectively support the user to 1) design a social product, 2) generate the Arduino code, and 3) test the product behavior. Three groups of 2-3 people have been formed and worked according to a design brief concerned with developing an alarm clock that motivates the owner to wake up on time. All the material (plastic balls, lego bricks, cardboard, etc.) available in the lab where the test took place could be used to create the physical prototype, as well as a set of sensors, and an Arduino board. After familiarizing with the features of *sense.me*, members of each group worked together on the conceptual design of a single physical prototype. Then, each participant was requested individually to detail the concept through the creation of a virtual prototype and make the physical prototype able to publish posts in Facebook according to the events defined in *sense.me*. At the end of the design phase, participants were also asked to generate the Arduino code and test their prototype.

A "think aloud" protocol was adopted to gather comments during the interaction with *sense.me*. A final questionnaire was submitted to the participants to investigate whether *sense.me* facilitates the development of social products and how it combines with product designers' creative process; perceived benefits and limits related with the experience of using *sense.me* have been also inquired, as well as possible future extensions, such as other social behaviors and social networks to be included in the framework.

Findings have been encouraging: 7 out of 8 participants agreed that *sense.me* helps in designing innovative physical artifacts, especially because it gives the possibility of connecting them to social networks. Moreover, all participants appreciated the simple interaction with *sense.me* and its powerfulness related with the possibility of generating Arduino code without any programming expertise. As to the test phase, only one participant declared to have some problems in recognizing the correct button for accessing the test page; this was actually a usability problem, which was easily solved. All limitations highlighted by participants are due to the prototypal nature of the system, such as the limited number of available social behaviors and sensor types. Participants suggested also to provide the possibility of creating AND/OR combinations of sensors and of associating a complex social behavior to one sensor.

4. CONCLUSIONS

sense.me can be regarded as a proof-of-concept that demonstrates the feasibility and usefulness of a tool that supports industrial design students in prototyping social products. Limitations emerged during user tests are being overcome; in particular, we have already enriched *sense.me* with further social behaviors of a variety of social networks, by exploiting the code made available by Temboo [[9]]; then, features for sensor combination and complex behavior definition are under development. Another planned future extension concerns the support for creating physical objects able to react with their actuators to data coming from social networks. This will open up the application of the framework to novel Internet of Things scenarios.

5. REFERENCES

[1] Arduino. http://www.arduino.cc/.

[2] Ballagas, R., Ringel, M., Stone, M., Borchers, J. 2003. iStuff: a Physical User Interface Toolkit for Ubiquitous Computing Environnments. In *Proc. of the SIGCHI Conference on Human Factors in Computing Systems* (Fort Lauderdale, FL, USA, April 2003). CHI '03. ACM, New York, NY, 537-544.

[3] Carulli, M., Cugini, U. 2010. An Integrated Framework to Support Multidisciplinary Design Processes. In *Proc. of the 8th Int. NordDesign Conference* (Göteborg, Sweden, August 2010), 323-332.

[4] Hartmann, B., Klemmer, S. R., Bernstein, M., Abdulla, L., Burr, B. Robinson-Moscher, A., Gee, J. 2006. Reflective Physical Prototyping Through Integrated Design, Test and Analysis. In *Proc. of the 19th Annual ACM Symposium on User Interface Software and Technology.* (Montreux, Switzerland, October 2006). UIST '06. ACM, New York, NY, 299-308.

[5] Lieberman, H., Paternò, F., Wulf, V. 2006. *End-User Development*. Springer, Dordrecht.

[6] Costabile, M.F., Fogli, D., Marcante, A., P. Mussio, Parasiliti Provenza, L., Piccinno, A. 2008. Designing Customized and Tailorable Visual Interactive Systems. *Int. J. Softw. Eng. Know.* 18(3), 1-21.

[7] reaDIYmate. http://www.readiymate.com/

[8] Shaer, O., Hornecker, E. 2010. T\angible User Interfaces: Past, Present, and Future Directions. *Foundations and Trends in Human-Computer Interaction*, 3(1-2), 1-137.

[9] Temboo. http://temboo.com/