Milky: On-product App for emotional Product to Human Interactions.

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Abstract
In this paper we present a new way of emotional interaction with products. Based on the rapid prototyping Microsoft Gadgeteer platform, we concretized our vision of an on-product app by implementing an anthropomorphic intelligent milk carton. The purpose of this realization is to give customers a better view of a product's life-cycle. This realization also demonstrates that the frontier between pure mobile applications development and the creation of tangible objects is very thin and opens new way to integrate the Internet of Things over an anthropomorphic user interface, thus leading to a new product to human interaction form.

Author Keywords
Product to human interactions, tangible objects, Gadgeteer, embedded Platform, emotion, anthropomorphic, product life-cycle, Internet of Things

ACM Classification Keywords
H.5.2. [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces.

General Terms
Design, Human Factors, emotions

Introduction

Intelligent physical objects or tangible entities are getting more and more popular due to the usage of rapid prototyping framework like Gadgeteer or Arduino, enabling the creation of customized hardware by applying principles of mobile development. Indeed the manner on how intelligent physical objects and by extension products can be implemented are very similar to the mobile app paradigm. On the other side, products are also following a so called "lifecycle" with several steps including the reseller and the customer. Through all these steps it is important for the buyer to know in which condition or state a product is. The product lifecycle can be tracked over two possible approaches. The first one described as "incycling" [6] follows the principle that RFID removable smart labels can be placed onto a product and once the product's lifecycle is over returns to the producer helping the consumers to reduce their personal waste. [5]. In addition, the producer is able to read and statistically analyze the stored information. This second approach presented in [8] [7] relies on the fact that customers will be able to check the object's internal product's memory over a specific web portal. Often the views presented are targeted for logistic or technical scenarios, in which the end consumer is not directly implicated or can hardly quickly extract relevant product information for his own purpose.

With the idea of an intelligent milk carton we demonstrate how a product lifecycle can be visualized in a new way, directly onto the product so that customer can easily check the product's information and by extension its internal object memory model, one of the fundamentals of the Internet of Things.[3] [2]

Motivation

1999 the English rock band Blur won several awards for their video clip called "Coffee and TV".[4] In this music video clip, an anthropomorphic milk carton was changing its mood and face depending on the emotions it had during its adventures through a city.

Figure 1. Milky, the anthropomorphic milk carton [4].

Inspired by this video and partly by the work presented in [11] and the opinions expressed in [10] we decided to create an intelligent milk carton in order to demonstrate that users can easily interact with physical objects (or products) over a simple user interface using several input modalities (touch screen, sensors) and connectivity modules (WLAN, ZigBee). Moreover the emotion generation part plays an important role as each state and condition of the product will be displayed as an animation on the product itself.

Figure 3. Pictures of the milk carton with the Gadgeteer touchscreen integration

Hardware

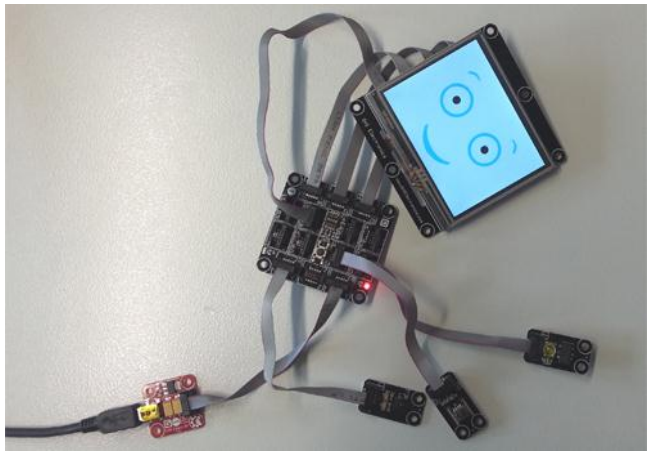

Figure 2. Components used for the realization of Milky

The heart of Milky, the intelligent milk carton is a GHI Electronics Spider Board running the .NET Framework. A 3,5'' touchscreen display in front of the milk carton enables user touch-inputs and the direct display of information and emotions in form of an animation or an inbuilt application (Figure 2). By touching the display users can switch between those views. A network layer connected over a WLAN module enables Milky to send its current condition to a server but also to receive data from the Internet. To gather information about the product's current condition we have used a moisture and temperature/barometer sensor combined with an accelerometer and gyroscope module to count the number of times the milk carton was opened and used. A barometer module analyzes the current weather situation and will check if the milk is going to sour in the following hours. Additionally a mobile battery provides the power supply for the modules and the Gadgeteer board.

Software architecture

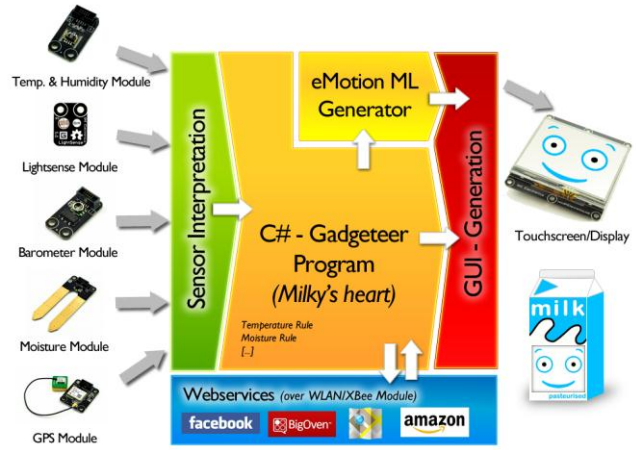

Figure 4. Framework architecture of Milky

The framework is written in C#, the standard programming language for the .NET framework. It manages the interpretation of sensor information and triggers over a rule engine called "Milky's heart" the different emotional states of the milk carton. Once a rule has fired, the sensor interpreter generates an emotionML (emotion MarkUp Language) -based message [9]. This message is then analyzed by the graphical output module in charge of the visualization of the product's current lifecycle state and of the display of the corresponding emotional animation (e.g. smiling, sad, happy). These emotional states can be specified by the product's manufacturer or the vendor

Figure 5. Screenshots of the application running on the Gadgeteer Board of the milk carton. The user can switch between several views (I like it – Recycling points - Buy Again)

depending on a predefined marketing strategy: Milky can smile and play a sound to raise the attraction of new customers in the shop.

On-Product Life-cycle visualization and user experience

The embedded framework can be used in several scenarios implying the usage of product life cycle management. Through the emotive component, the user will experience a new kind of interaction by directly getting accurate details about the product's current condition directly on the screen.

The first state is the "Buy Me" mode, when the milk carton is present on a shop shelf. The milk carton tries with blinking eyes and an acoustic feedback to catch the attention of customers. The proximity sensor and accelerometer sensor detects the fact that the customer is going to take the product from the shelf. Once bought, the shop activates a new mode as the product now belongs to the customer. At this moment the sensor data tracking module is activated and all parameters such as temperature variations or moisture are tracked. In the same manner the customer will be also informed when the eat-by day is up. The consumer can also switch between two views, the first one being the face of Milky and the second one showing a more factual view by displaying the sensor's raw data values. Depending on the content of the milk carton a personalization module can be started; strawberry milk could be presented as a pink face on the display.

At each states of its lifecycle the product communicates with the Internet over WLAN enabling extended features such like online retrieval of recipe suggestions by using the BigOven API [1] (Figure 6).

Figure 6. The milk carton makes a recipe suggestion

Once the product is no more consumable e.g. due to an expiry of the eat-by day or because the customer has completely used it, Milky goes into the "Dead"-state. In this mode three options are displayed on the screen: the first one displays a Google Maps with the nearest recycling stations -assuming the milk carton knows its location over the GPS module - so that the recycling chain will not be broken. This is particularly interesting for optimizing the product's carbon footprint. The second option allows the customer to share his "product-experience" over Facebook with a virtual "I like it" button so that he can tell over his social network that he loved the product he has just consumed (Figure 5). Brands could gain a lot of publicity and consumer feedback over this interaction form. With the third and last option the product asks the consumer if he would like to buy the same product again and

synchronizes the decision over the user's Amazon profile: this can be considered as a tangible One-click buying interaction (Figure 7).

Figure 7. The product' s lifecycle has ended: Milky displays the option to buy the same product again over Amazon.

Conclusion and outlook

With Milky we demonstrated, that through a seamless combination of sensors, an integrated emotion generator and output modalities such as sound and a touchscreen, physical objects and products can easily be turned into intelligent tangible entities. The direct on-the-product visualization of the current product lifecycle's state also opens new interaction possibilities. Of course due to cost-efficiency the scenario we've explored might sound a little bit complicated to be currently applied on mass market product, as rapid prototyping platform hardware component are rather expensive at the moment for massive in-product integration. But for low-budget integrations, the .NET Gadgeteer Board could be reduced to a smaller board (e.g. a GHI Cerberus) with a single RFID (Radio-frequency identification) chip, permitting consumers to check a product's state or condition over a mobile device or a mobile app instead of directly interacting with the physical object itself. Nevertheless, we are confident that in the future - especially through miniaturization of hardware components and the lowering production costs of flexible displays - some products will integrate this form of new emotional product to human interaction.

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