SMART BEER COASTER

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ABSTRACT

The main objective of this paper is to describe the different stages of research and development of an electronic device based on the use of open source technology which is the result of the observation of the consumption and sales habits of 600ml beer bottles in Brazil, as well as the relationship between bars/restaurants and their customers. This project's goal is to optimize this business, being both commercially attractive and capable of improving its consumption experience. Therefore, the prototype here presented is expected: 1) to warn the staff that the last bottle served to a customer is getting empty, allowing its immediate replacement and consequently reaching a higher level of client satisfaction; 2) to increase the efficiency and profit margin of the bar/restaurant by selling more beer; 3) to add value to the bar/restaurant and the brands associated to the device as a product, due to its technological and innovative nature.

KEYWORDS

Design, consumption, beer, interface, communication

1. INTRODUCTION

The increase in the development of open source technologies and the price reduction of electronic components have facilitated the prototyping process of gadgets in the most varied areas of knowledge.

Aware of the actual relationship between bars/restaurants and their customers, we noticed the possibility of using technological resources to optimize it. Based on a study on the service of selling and consuming 600ml beer bottles, we can point out some conditions and characteristics of this activity flow that could be modified and optimized with the aid of smart and ubiquitous technologies, according to the list below:

- To request a new beer after consuming the previous one, the customer needs to realize that their beer has finished and calls the waiter with a gesture or word. In many cases, the waiter is not immediately within the customer's scope of vision or not aware he has been called, which results in a delay to get more beer. In a greater scale, with a large number of customers the hypotheses is that such waiting to drink tends to represent a potential loss of consumption by customers and sales by the bar/restaurant;

- The bar/restaurant needs, especially at peak times, a greater number of waiters resulting in their circulation around the work place in an irregular way. On the other hand, an organized and well planned circulation allows a coverage of the whole useful area with less staff and less waste of time;
- The staff, since they do not have precise information on which tables need service, increase their stress load and physical effort in the process of constantly supervising customers' consumption, which, in the long run, may result in a reduction of satisfaction and service capacity.

2. PURPOSES

Our first purpose is the research on the technical matters for the development of the intended prototype, in addition to the use flow and its requirements, so that it may increase efficiency in the beer sales service.

With the prototype correctly implemented and configured for the service of selling 600ml beer bottles from Ambev, a Anheuser-Busch InBev company, the focus is to provide a system that warns the staff as the container becomes closer to the "empty" status and requires its replacement, giving more satisfaction to customers and making the work flow more efficient, which tends to sell more beer in a given amount of time.

Due to the fact that it has been entirely developed by using open source technologies, the prototype presents a low-cost solution, with an initial investment that may be easily recovered as revenue increases and, consequently, as the profit margin of the bar/restaurant increases too, considering the optimization of the service flow provided by the use of the device.

Likewise, one of the goals to be achieved with the use of the prototype is the optimization of the staff shift schedule, allowing the bar/restaurant to provide a better service with fewer employees.

Finally, there is a concern to develop a device in which its attributes – such as its design as well as its innovative and technological characteristics – become themselves an attraction to the customers, a user friendly item that could be perceived as a product that adds value to the bar/restaurant's service in general.

3. TECHNICAL SPECIFICATIONS

The solution adopted in the project consists in two essential elements: coaster and receiver. The coaster, which provides support to the container (beer bottle) and records the pressure it exerts on its surface (contact area), forwards data via radio to the receiver from time to time – which will be connected to a computer with an application and graph interface to the intended goal – in such a way that it is possible to follow up the status of the container and its prospective replacement. The information obtained in this process may integrate a logistic and automation system to control the consumption of the table where the coaster is located, as well as the stock of products available in the bar/restaurant.

In order to gather and send to the receiver the data containing the pressure exerted by the container, the coaster must have the following items:

1. Square Force Sensitive Resistor – code SEN-09376, price: U$7,90 at SparkFun Electronics;
2. Arduino Fio – code DEV-09712, price: U$24,95 at SparkFun Electronics;
3. Polymer Lithium Ion Battery - 1000mAh – code PRT-00339, price: U$11,95 at SparkFun Electronics;
4. XBee 1mW Chip Antenna – code WRL-08664, price: U$22,95 at SparkFun Electronics.

For the receiver, the following items were used:

1. XBee Explorer Dongle – code WRL-09819, price: U$24,95 at SparkFun Electronics;
2. XBee Pro 60mW Chip Antenna – code WRL-08690, price: U$37,95 at SparkFun Electronics.

For economic reasons, it has been used the minimum number of parts in the prototyping, both for the coaster and the receiver, in such a way to make the solution feasible within the current market scenario. Besides, there is a clear concern in relation to the physical space occupied by the devices comprising the coaster because its dimensions cannot exceed those of the typical cork coaster. Therefore, we decided to use the Arduino Fio, which is compact, being equipped with a socket for XBee and connector for Li-Po battery. However, its mini-USB connector serves only for the purposes of recharging the battery.

The programming of the coaster is made remotely from the XBee Explorer Dongle that integrates the receiver, being unnecessary to connect the Arduino Fio to a computer. However, to recharge the battery that

feeds the board, it is necessary to connect it to a USB power source. Replacing the discharged battery by a charged one would also be a possible solution.

Although the container, that shapes the coaster and accommodates the four items it contains, has not been built in this project, we estimate that its dimensions are approximately 90 x 90 x 22mm (length x width x height), being different only in height in relation to the common coasters.

As to the receiver, the option fell upon XBee Explorer Dongle, which has a connector/USB feeder, and a socket for XBee; the latter, in turn, was occupied by a 60mW XBee Pro to ensure communication with the coaster 1mW XBee, since it is not possible to know the oscillation of signal in view of innumerous physical barriers (walls, pillars, people, etc) between both XBees, at distances higher than 15m.

The size and format resulting from the combination described above cause the receiver to have an appearance similar to that of a pen drive, although, just like the coaster, an enclosure has not been built to protect the equipment and make its handling easy.

4. PROTOTYPE: TECHNOLOGICAL ASPECTS

When assembling the prototype, a series of customizations have been done, starting with the receiver, which, in order to be capable of programming the coaster via radio required to have the XBee Explorer Dongle modified with the purpose of restarting the Arduino Fio remotely, a procedure which is essential to the operation. Therefore, a small jumper was welded between RTS and D3 pins, in such a way to bind the D3 status to the RTS, which, in turn, may be set to function as a reset pin of Arduino.

The power sensor chosen for the prototype has the biggest sensible area available in the market – 40 x 40mm – which allows the measurement of the pressure exerted by an object with an acceptable precision level. However, if the measured object is a bottle, one noticed that it required a material with a flat and hard surface applied to the sensor, preferably of the same size, to serve as a support, protection and ensure that there is pressure only in the useful area of the sensor.

A small modification has also been made in the sensor: machined sockets were placed in its outputs in order to facilitate its connection to the prototype, thus, avoiding the use of welding.

To feed the coaster, a 1000mAh Li-Po battery was used, which ensured to the prototype 12 hours of autonomy. However, depending on the alterations in the code – for example, by selecting the power economic mode of Arduino and turning on/off the XBee at every interaction with the receiver's XBee – we believe that the battery is capable of keeping the coaster in operation for about 120 hours.

Arduino Fio has undergone some adaptations. In the beginning, two rows of machined sockets were installed in the device, each on the existing sequence of pins, to facilitate the connection of wires, which resulted in a more practical and elegant solution.

Next, to avoid unnecessary welding and, thus, ensure the physical integrity and good appearance of Arduino Fio, a piece of standard board was used – attached with double-face adhesive tape to the surface of Arduino – to accommodate the other end of the wires, a resistor and a pair of machined sockets intended to work as a connector for the power sensor.

With respect to the prototype for the coaster, it is important to clarify that the power sensors are basically resistors changing the value of their resistance (Ω) according to the pressure exerted on it. Therefore, the simplest way to read a power sensor is to connect one of its outputs to a power source and the other to a resistor - in this case, of 10Kohm – connected to earth (GND). Next, the point between the resistor and the sensor should be connected to one of the analog inputs - in our case, an A0 input was chosen – of Arduino.

Since the working voltage of Arduino Fio is 3.3V, the analog voltage reader will vary from 0V (earth) and 3.3V, that is to say, the same voltage of the power source.

When the resistance of the power sensor falls, the total resistance of the sensor and the 10Kohm resistor also fall – of approximately 100Kohm to 10Kohm – which shows that, when the current passing through both resistors (sensor and resistor) increases, the voltage existing in the 10Kohm resistor increases accordingly.

In the end, the coaster prototype created, as shown in Figure 1, not only works with a reasonable faithfulness, but also occupies a small space (volume) – perhaps the smallest possible among the options with Arduino provided in the market – capable of assuming, except for its height, dimensions compatible with those of a common coaster, at a relatively reduced cost.

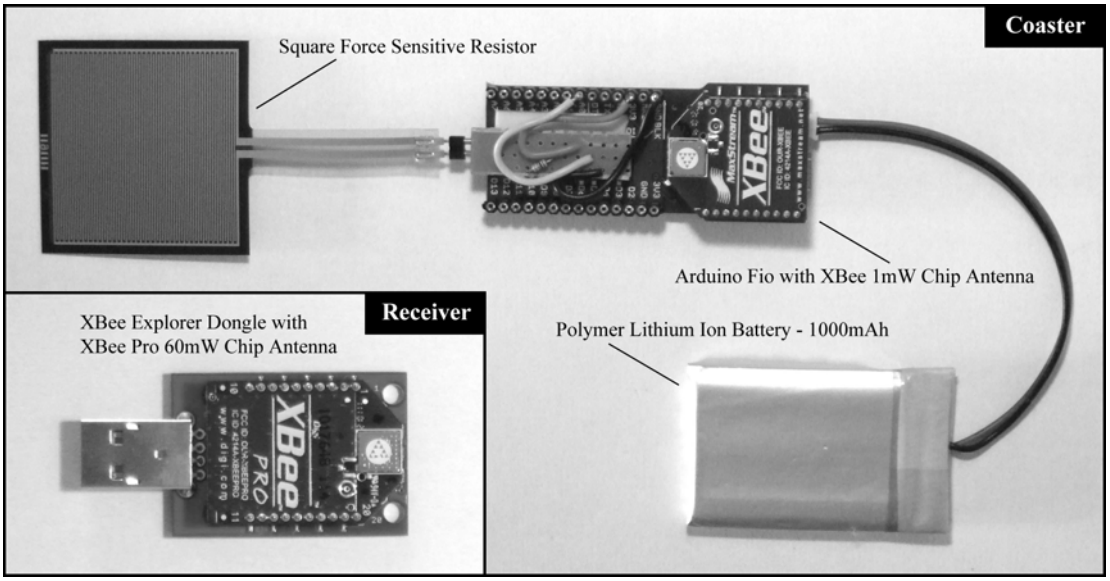

Figure 1. Prototype for the coaster and receiver

We created the code used for the test, which shows in the screen, at every 3 seconds, the amount of pressure recorded by the device. Specific messages are also established for each pressure stretches characterizing the container content level, without the need of making any calculation.

It is important to say that the messages created already suggest the use of that scheme in more than one coaster, and for each of them there is a unique identifier and an association to the table where it is located, in order to ensure the efficacy of the solution in a real situation. The result achieved may be noticed in Figure 2.

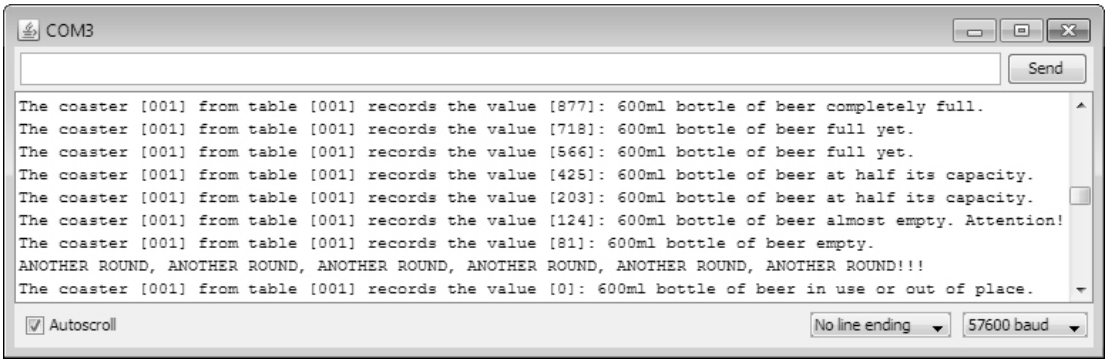

Figure 2. Graphic

5. CONSIDERATIONS ON THE DESIGN OF THE FINAL PRODUCT

About the coaster, the receiver and its interface with the user, some considerations should be taken. The coaster must be built in such a way to resist the contact with liquid, since its use supposes that beer would be spilled onto the equipment. Thus, the upper surface of the coaster and its side area should consist in a single part with a continuous surface without spaces. A similar solution should be adopted for the coaster base, establishing side parts to it. The material used could be high density polycarbonate or polyethylene.

Once the coaster enclosure is defined, the electronic parts located inside it will be fully protected due to the fact that no liquid spilled over the coaster will slide down by the sides of its upper part, being kept outside with no risk of infiltrating into the equipment, since the sides of its lower part will block such passage.

Another important aspect is to consider that the upper part cannot move horizontally in relation to the lower part, and the upper part should have a gap to fall down and pressure the power sensor. To solve this matter, the parts can be united by an internal spring system, which will provide sufficient resistance so that the sensor is capable of recording the zero and maximum pressure status, according to Figure 3.

Figure 3. Coaster enclosure

The coaster base should be made of some sort of material that can provide more attrition with the table, in order to avoid displacements. Thus, the application of a rubber film on the external surface is recommended.

Regarding the receiver, the data received must be changed into information for its final user: the waiter. Therefore, the final interface of the system should consider the quick diagnosis of the following variables:

- The priority to supply beer given by the waiting time of the next bottle: the longer the waiting time is, the more urgent the service should be. The presentation in a list format is a suitable visual solution;
- The reading of the interface by the waiter, which should be made quickly and, eventually, while he moves around the bar/restaurant. Therefore, the interface may be presented in a large screen that would serve not only to waiters, but also to customers;
- The position of the table in the bar/restaurant, to make it easy for the waiter to find it. A diagram representing the low plan of the site, in a schematic way, may be useful.

6. CONCLUSION, RELEVANCE AND DEVELOPMENTS

This project presents an evolution in the relationship between bars/restaurants and their customers. The result benefits both sides. The company's operation is optimized in such a way to generate more profits. The beer suppliers and producers also benefit from it just as the brands associated to the service (the bar/restaurant's beer brand or the product brand itself) incorporate values such as innovation, technology and pleasure.

More than a technological innovation, this proposal has a potential to become an innovation in the experience of entertainment among the public attending bars and restaurants. Using the information gathered by all tables may become, for instance, an argument to some kind of gratification for the tables completing a specific number of beers consumed, creating a game mechanics where the customer participates by simply being at the site. If the interface serving the staff is also visible to everybody in the bar/restaurant, the competition character will become even more evident when exhibiting the number of beers consumed by each table. In this case, this very interface may provide animations that emphasize the participants who are receiving more awards, in order to encourage customers to increase their consumption.

The innovative nature of the device entails the need of further studies, from its implementation in a real environment, in order to observe in more detail the consequences of its use and its social implications. From this point on, it is possible to promote changes in the proposed flow to offer a better consumer experience.

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