

# Mobile Phone Interaction with Outdoor Advertisements

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## ABSTRACT

Outdoor advertisements are increasingly unable to capture the attention of passers-by. Their content is mostly ignored, easily forgotten and cannot convey much information. One way to improve user experience with billboards is to make them interactive. This paper presents an approach to Digital Interactive Advertisement which allows creating digital billboards capable of interacting with people using Bluetooth-capable mobile phones. We present a user-centred approach to designing the system, and discuss the main challenges posed by casual non-expert interaction. Indeed, designing outdoor systems for casual use adds interesting challenges to the design of walk-up and use systems, where there is not a obvious motivation or need to interact with the system. We describe the approaches we took to entice users and maintain interaction and how to increase the amount of information exchanged and made available via the billboard without demanding a high cognitive effort from the users. Preliminary evaluation results with 12 users, while encouraging, point the way to further enhancements and have suggested interesting new approaches.

## Author Keywords

Advertisement, Mobile Phones, Bluetooth, Billboards, Interaction.

## ACM Classification Keywords

H.4.3 [Information Systems Applications]: Communications Applications – Information browsers; H5.2 [Information Interfaces and Presentation (e.g., HCI)]: User Interfaces – Evaluation/methodology.

## INTRODUCTION

Current outdoor advertisements are notoriously unable to capture people's attention, thus creating the need for innovation in this area. Even when an advertisement is able to capture someone's attention, it is easily forgotten. On top of that, nowadays people have less time than ever to spend searching for information about a product and there is scant information available in billboard advertisements.

Our work tries to address these issues and bring innovation to the street ads, providing a new experience for its users and allowing advertisements to reach consumers in new ways.

There are many public places such as bus stops and subway stations, where people are waiting idle without doing anything that involves mental effort. So, there is an opportunity to engage their attention by making it possible to interact with billboards. Since almost everyone has a mobile phone, with near-communication capabilities such as Infra-Red, Bluetooth and even WiFi, these devices seem provide a good platform to develop interaction techniques.

We intend to take mobile phone exchanges with outdoor ads a step further by allowing more complex interactions than those developed so far.

## RELATED WORK

There has been some research on IT-enabled outdoor advertisement and some interesting products have come out of that research. The store front window [1, 2] developed at MIT's Media Lab and the YDreams's Interactive Shop Window[3] are two examples of such products. Both these systems transform shop windows into interactive surfaces. Such systems usually allow only one user interacting at a time and do not allow any exchange of data between the system and any device carried by people.

Research has also been done on using mobile phones to interact with public displays. On the Hermes Photo Display [4] users can send pictures from their mobile phones to a public display by using Bluetooth and download pictures from the system. Although this idea is quite interesting, the system has some drawbacks. Indeed, sending and downloading pictures requires pairing the Bluetooth devices even though such exchange could be done without pairing.

Interaction is also somewhat limited as Hermes is basically a photo sharing system. A similar Bluetooth-based system, ContentCascade [12] allows people to download information from public displays via an application installed on their mobile phones. Again the interaction is restricted to a one-way transfer of data, which we find very limiting. Another problem with this system is that it is a client written in C++ for Symbian OS, which greatly limits the number of phones compatible with ContentCascade. One other system that uses mobile phones to interact with public displays is MobiLenin [5]. With this system, users were able to compose a video clip together by voting on the parts they wanted to include. In this way the system creates a cooperative environment that promotes socializing. However, the MobiLenin relies on GPRS, a paid service on cell networks, which could drive some users away. Furthermore the decision to write code in Python for the Symbian OS may prove limiting and less flexible than using a web application, accessible via a web browser, since the system uses HTTP to communicate over GPRS.

There have been some attempts of joining these two worlds with some success. YDreams's Street Furniture [6] is a system in which a billboard asks passers-by to pose for a picture. After the picture has been taken, people can download it to their mobile phones. Since the communication between the billboard and the mobile phone is done through an infrared signal, users are forced to align their mobile phones with an infrared sensor on the display. The interaction is also quite limited since the system only allows downloading the last picture taken. Recently the Hypertag Company [7] entered this field with a billboard that is able to send multimedia content to mobile phones via Bluetooth or infrared signals. Unfortunately, the billboard itself is just a classic outdoor ad, meaning that no computer screen is used, just a paper poster. However, using several antennas for communication allows the system to interact with many users without creating much lag on each connection. YDreams also created two other products that combine mobile phones with outdoor ads. The first is the Vodafone Cube [8], a giant cubic display placed in front of the Vodafone headquarters in Portugal where users can play 3D games, watch promotional videos and interact with product demonstrations. The main drawbacks of this system are in that there is no interchange of information between the system and the user's phones and the communication (Dual Tone Multi-Frequency<sup>1</sup>) requires using paid services. The other system developed by YDreams was the Adidas Eye-Ball [9]. This system consists on a giant display equipped with motion and sound sensors. People can chase a ball displayed on the screen to have the system provide feedback on their running speed or shout as a group to see which soccer team has the loudest fans. People can also send SMS messages that affect the content presented on the display. However, the con-

<sup>1</sup> The global standard for audible tones that represent the digits on a phone keypad

test to see who makes more noise can be very annoying for other by-standers who are not participating. Finally the BluScreen system [10] takes a different approach. The interaction between the mobile phone and the display is passive since the user does not actively engage in the exchange. The BluScreen display, presents several commercials and takes into account the mobile phones found in the area in order to compute the exposure time for each commercial. Although this is an innovative idea, this system doesn't allow interaction with the users.

### THE PUBLIX SYSTEM

The first thing we had to decide when designing Publix was how the mobile phones would communicate with the system. We considered several means of communication like GPRS, Wi-Fi, infrared, SMS / MMS and Bluetooth. Since GPRS and SMS / MMS are paid, we decided not to use them. Infrared has the disadvantages of only allowing one user to interact at a time, having a very low bandwidth and needing to align the mobile phone with the sensor in the billboard. Wi-Fi would be a great choice but, unfortunately, there are very few mobile phones that support Wi-Fi. Bluetooth, although not having a very high bandwidth, is a common feature in today's mobile phones, allows multiple user interaction, enables us to detect the presence of mobile phones near the billboard and is free.

After deciding we would use Bluetooth, we had two choices; use just the built-in abilities of the mobile phones (which would only allow the exchanging of contents between the mobile phone and the billboard) or developing an

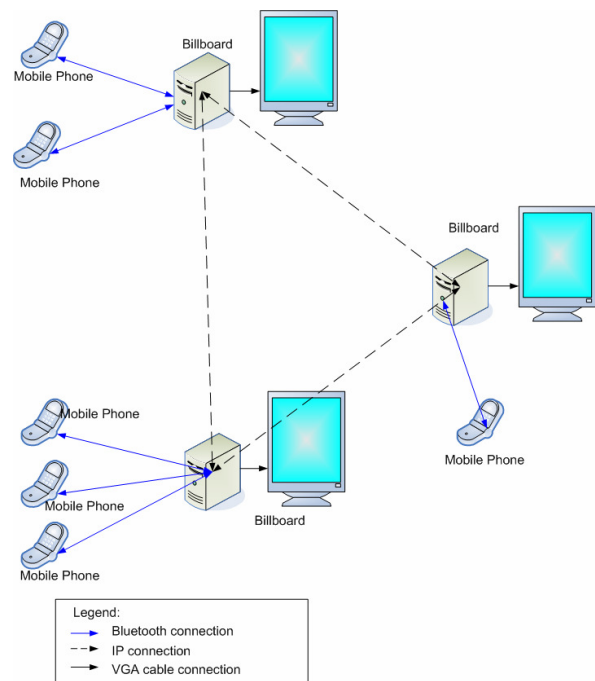


Figure 1 - Publix System organization



Figure 2: screens showing game play on mobile phone

application in order to allow more complex interactions. If the application was to be built, it should be developed in Java 2 Micro Edition (J2ME) so it would be compatible with most mobile phones. Since the Bluetooth API for J2ME (JSR-82) exists on several mobile phones [11], we decided to develop this application (called PublixMobile).

#### Sending Pictures to the Billboard

The simplest interaction with this system allows people with Bluetooth enabled mobile phones to send pictures to be displayed on the billboard. When we designed this functionality, we encountered a problem. The user could, by mistake, send the wrong picture and therefore might want to remove it. To solve this issue we created a system in which, whenever a picture is received, a receipt that uniquely identifies that picture is generated and sent back to user's phone. If the user wants to remove the picture from the billboard he/she just has to send the receipt in the same way the original image was sent.

#### Inviting Users to Download PublixMobile

Installing an application on their mobile phone is something many people might not want to do due to justified fears about viruses and malware. We had to come up with incentives for people to download PublixMobile. Besides, providing a free means to receiving the application, other incentives include exclusive promotions such as ring tones, wallpapers or movies made accessible through PublixMobile. The access to such promotions is granted by downloadable coupons.

#### Game component

Another way we found to invite interaction was to supply our system with a ludic component. Publix has a memory game users can play using both PublixMobile and the billboard. The objective of the game is to find pairs of matching pictures in a game map shown in the billboard. The pictures used to fill the game map are chosen among the ones sent by users to the billboard. The mobile phone representation of the game map only shows if a game cell is occupied or if it is still free. This makes the user look at the billboard thus increasing his exposure to the ad and aware-

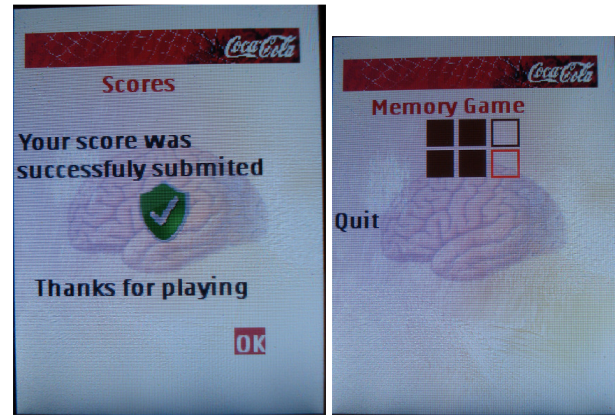


Figure 3: screens showing game play on mobile phone

ness of the relation between the mobile phone and the billboard display. We have implemented a simple memory game whereby the user has to match figures in pairs by selecting their positions on the billboard, using the mobile phone joystick or cursor keys. Figures 2 and 3 show two different screens on the mobile phone, while Figure 4 shows an user interacting with a simulated billboard on a large screen display. Only one user can play the game at any given moment but any interaction other than playing can be executed by other users while the game is being played.

#### Proximity Marketing

To be able to stimulate user awareness of the billboard and to make the advertisement reach the maximum number of people, we used a technique called proximity marketing. This technique consists on Publix searching for mobile phones with Bluetooth discovery mode active every few minutes. When a mobile phone is found, Publix checks if it has any digital flyers that haven't been received by that phone. If a flyer is found that hasn't been received by the mobile phone, it is sent to that phone through a Bluetooth connection. Taking into account the fact that some people may find this interaction bothersome, we decided to try to minimize the number of people that would be bothered. This was achieved in the following way, when someone refuses a digital flyer sent by the billboard, the Bluetooth address of the phone to which the flyer was sent is saved as not wanting to receive any flyers. As long as a mobile phone has his address in the list of addresses that aren't supposed to receive flyers, no digital flyer is sent to it. PublixMobile allows users to check and change the status of the digital flyer reception for their mobile phones.

#### Billboard Network

Because there can be multiple billboards presenting the same advertisement, some information must be shared between them. Because of this, we created the possibility for the billboards to be connected in a network so they can exchange information about high scores and, more importantly, information about what flyers have been successfully sent to which mobile phones and which mobile phones

should not be sent any flyers. The sharing of information about digital flyers and mobile phones guarantees that a user doesn't receive the same flyer from different billboards nor refuses a flyer from one billboard and then receives it from another.

### IMPLEMENTATION DETAILS

In this section we will discuss the problems we faced while developing the system and introduce the main outcomes of task analysis (we did a survey with dozens of participants using the Internet and polling our colleagues and other mobile phone owners) and the first three prototypes we implemented.

#### How do Users Learn How to Interact?

Since Publix is designed to be placed on the street and be a "walk-up-and-use" application, we needed to approach the problem of how the users learn about the possible interactions they can perform with the billboard and how they can do it. To address this issue we introduced the possibility of presenting short explanatory messages on the billboard to inform the users what functions are available. The billboard only displays one message at a time but periodically changes the message presented. These messages explain how to send pictures to the billboard, how to download the application, or even the advantages of installing PublixMobile, the interaction applet.

#### How to Make PublixMobile Available for Download?

The easiest way to make PublixMobile available for the users is to put it on a web server and give the address for downloading it in the billboard. But, since GPRS communication is paid, many people would not download our application. To solve this problem, our first idea was to detect the Bluetooth pairing of devices with the computer running the Publix system and send PublixMobile to any mobile phones that paired with it. Unfortunately, due to technological limitations of Windows XP's Bluetooth stack, we were unable to detect such pairing of devices.

Taking into account that digital cameras are quite common on mobile phones, we created a new way to request the application. A user just has to send a black picture to the billboard and Publix sends back the jar with PublixMobile.

This solution presented two other issues. The first is the fact that not all phones have digital cameras, which makes it difficult for some users to download PublixMobile this way. This is solved by combining this method of download with the GPRS method already mentioned. The combination of both these methods also solves the problem of some mobile phones being unable to install an application from a jar that was sent through Bluetooth. The second issue raised by the black photo solution is the fact that, some mobile phones, when you cover the camera lens, don't take totally black photographs, they introduce some colored pixels in the picture. To solve this we developed an algorithm that is able to check if a photo is black enough.



Figure 4 - User playing a game on the Publix System

#### Adapting the Publix System to Different Content

The Publix system was built with the intent easily supporting different ads and games. This meant that both the billboard and the mobile application had to be configurable to have different look-and-feel, content and behaviors.

### EVALUATION

After building the Publix System we tested it with some users in two different tests. The first was a traditional test in which the users performed a series of tasks and was used to find out if the system was easy to use and the interactions were simple enough. The second test was a more open test in which we wanted to find out if the users were able to interact with our system without help and what were the functionalities from PublixMobile more appealing to them.

#### First Test

In this test the users had to perform eight tasks: download, install and run PublixMobile on their mobile phones; download a Portuguese music midi ring tone; read and save the information about the energetic value of the product; read the information saved in the previous task; download a promotional coupon; play a memory game in the normal difficulty; ban a photo from the billboard; change the digital flyer reception state with PublixMobile.

Since the Publix system was designed to be installed in places like bus stops, we would only get around ten to fifteen minutes for the users to interact with the billboard. Having this in mind, we decided that downloading and installing the application should not take longer than five minutes and users shouldn't make more than one mistake on average (for example sending the black picture to the wrong device). Downloading a ring tone shouldn't take longer than one minute and ten seconds, taking into account the time necessary for the PublixMobile application to search for and connect to the billboard, and the user shouldn't make more than one mistake. Since the reading of any information is a quite similar interaction to the downloading of a file and saving that information requires one additional interaction after reaching the information menu (choosing the "save" option), we determined that this task shouldn't take

Tasks	Time (s)		Errors	
	Ave.	Sdev	Ave.	Sdev
Application download	191,5	51,1	0,1	0,4
Ring tone download	53,3	11,2	0,3	0,5
Save information	51,4	10,9	0,3	0,5
Read saved info	21,9	11,7	0,0	0,0
Download Coupons	46,4	15,2	0,3	0,5
Play game	156,9	16,1	0,3	0,5
Ban photo	41,6	6,2	0,4	0,5
Change Flyer state	37,6	5,6	0,1	0,4

**Table 1 – Results from the first user test (eight users)**

more one minute and twenty seconds and shouldn't generate more than two mistakes from the user. Considering that reading saved information doesn't require PublixMobile to be connected to the billboard, we decided this task shouldn't take more than forty seconds. The downloading of a promotional coupon has an interaction that is very similar to saving information, so we gave it the same limits as the third task. For the game we decided to have the time limit at three minutes and that the user shouldn't make more than two errors. The last two tasks have a similar interaction sequence so we gave them the same limits, fifty seconds and one mistake.

This test was performed with the billboard being simulated on a screen (using the powerwall large-screen display available in TagusPark) with a height of about two meters, every task (except for the first) was performed from the first screen of the PublixMobile application. The order in which the tasks were performed varied from user to user to make sure it didn't affect the results and the user was only told what the next task was, after he completed the current task. Eight users performed these tasks with ages between 19 and 28 years old, one of them had finished high school, six had a computer engineering degree, and one had a medical degree.

Before the test began we explained to each user what the system was and what it was able to do. At the end of each test, we had a conversation with the user in order to find out their opinion about the system and to get their suggestions.

Tasks	Mean Time (s)	Time std dev (s)	Average errors	Error std dev
Application download	224,5	31,9	0,3	0,5
Until end of game	444,3	186,8	1,5	1,3

**Table 2 – Results of the second test (four users)**

## Second Test

In the second test, instead of explaining to the users what they should do, we only told them that our work consisted of a billboard with which they could interact using their mobile phone and that they were able to play a game with it. Each user had to find out how they could play, and finish a game. By not giving the users any extra help, we were able to really see if our method of downloading the PublixMobile application worked. This test was performed by four users in the same room as the previous test. Two users were studying computer engineering, one was studying electronic engineering and the last one was a computer engineering MSc student. The ages of the users varied between 20 and 27 years old.

After finishing the game people were told to try out whatever they wanted with the system. This allowed us to understand what functionalities appealed more to them. At the end of each test, we questioned each subject in order to find out their opinion about the system and to get suggestions or criticisms.

## Results and Discussion

### First Test

On the first test all the users were able to complete the tasks within the time and error limits established. The most common mistakes made by users involved not realizing that a menu had more options than were presented on the screen because they didn't notice there was a scroll bar on the right side. One way to solve this issue would be to modify the FIRE library in order to increase the size of the scroll bar. Another mistake was in the game task, when some users were in the difficulty selection menu and reached the "normal" difficulty, they just pushed their mobile's selection button without highlighting the "accept" option. Since this last mistake was somewhat common, we think we should have simply removed the "accept" option and let the users press the selection button. One user also made a mistake when trying to download PublixMobile, he sent the black photo to the wrong computer. This happened because the name the Bluetooth sends is computer's name and the computer were Publix was running had the name LEME-VIZ. This issue is easily solved by changing the name of the computer (perhaps to Publix Billboard). From these results we concluded the interactions we designed were good but there was still room for improvements.

In conversations we had with the users after the test, all of them considered the system easy to use and said they would like to try it out on the real world. The chance to have their fifteen minutes of fame by sending pictures to the billboard

was greatly appreciated. Some users said that they would like to have the possibility of viewing the contents available for download before downloading them (for instance hearing a part of a ring tone). This was not implemented because the streaming of such content would cause a heavy load on the Bluetooth communications.

### *Second Test*

As in the first test, the time limits for downloading Publix-Mobile and completing the game were met by all users. In general users had no problems downloading PublixMobile, as soon as the message that explained how they could do it appeared on the billboard, they were able to perform the download. One user had some problem figuring out how he could interact with the billboard. Initially he concentrated on how to connect his mobile phone with the billboard. When he finally paid attention to the billboard, he read the message that explained the existence of the PublixMobile application and was able to install it. After finishing the game most users download ring tones and images. This supports our initial decision of allowing the users to download multimedia content to their mobile phones in order to convince them to install the application.

According to conversations we had with users after the test, they were satisfied with the system and considered it to be easy to use. One of them actually said that having one of these billboards on his usual bus stop would make the wait much more pleasant. One bad aspect pointed out by the users was the fact that, during the game, the billboard only showed the pictures corresponding to the selected game cells when the user selected two of them. In the opinion of these users, the billboard should present each picture immediately when the corresponding game cell is selected. With the results of this test we can conclude that the system can be used in a walk-up-and-use environment.

### *Comparing the Results of Both Tests*

The results of the second test weren't as good as the ones in the first test both in the time it took users to perform the task and in the number of mistakes they made. This was already expected since in the first test the users received much more information about the system, and were helped when they made mistakes and in the second test they were left on their own.

Even though these tests serve as an indication of the potential of the Publix system we know they aren't 100% conclusive since they were performed on a computer laboratory and, even in the second test, some information was given to the users. However, the best way to test this system would be to place a billboard in a public place and monitor the interactions users made on a day-to-day basis. Unfortunately, due to logistic and financial limitations we were unable to perform such a test.

### **FUTURE WORK**

The Publix system still has room for improvements. For example, even though the system is highly configurable,

changing the configuration involves modifying several files and can be somewhat tiresome. The creation of an authoring tool to manage the configuration for both applications and adapt the system to different advertising campaigns would make this task easier.

The memory game should be changed so that when one game cell is selected, the billboard immediately showed the corresponding picture. More games could be developed for this system like a crosswords game where more than one person could play at the same time cooperating to reach the end.

Developing a way in which the contents available for downloading could be viewed before downloading them would also be a good improvement.

Taking into account the idea behind the BluScreen system, we could apply it to Publix in a different fashion. When a mobile phone is detected, the pictures sent by that phone to the billboard should have precedence over the other photographs displayed by the billboard. This would enhance user's recognition and create incentives to repeatedly engage in game play.

### **CONCLUSION**

We think the Publix system presents a promising approach in the field of interactive advertisement and marketing, through casual gaming. Indeed, the system allows people to interact with advertisement billboards in public places in an easy way. While most initial goals were met, we believe the application for mobile phones can still be made easier to use and to install. Furthermore, we feel that casual gaming in public settings presents an interesting match to existing habits and could provide opportunities for collaborative social interaction through modest improvements to our current setting which is flexible enough to mediate multiuser interactions.

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