Creating Log Files and Click Streams for Advertisements in Physical Space

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ABSTRACT
Poster advertisement has a long tradition and is transforming rapidly into digital media. In this paper we provide an overview of how sensing can be used to create online and up to date information about potential viewers. We assess what application domains can benefit from continuous monitoring of visitors. As measuring with simple sensors is inherently error prone we suggest the notion of comparative advertising power which compares the number of potential viewers in different locations. We address user acceptance and privacy concerns and show technical mechanism to increase privacy.

Keywords
Outdoor advertising, tracking, targeted advertising, interactive billboards, public displays

INTRODUCTION
Traditional forms of advertisement include posters, wall paintings, billboards, street furniture, etc. As public displays become more and more available, they provide novel, digital advertising space. Digital advertisements overcome several disadvantages of traditional displays like static content and can be used to create targeted advertisements, tailored to a specific group of people.

The combination of electronic displays with different types of sensors for gathering context allows both online assessment as well as an estimation of the numbers of passersby or even viewers. This can be achieved by using different techniques such as Bluetooth scanning, motion detection and image / voice recognition. Hence, our approach focuses on means for using this data to create information similar to page views and click streams, known from the WWW.

Important artifacts that help to achieve this goal are mobile phones. Many mobile phones support Bluetooth and some percentage of people has it turned on. Thus, it is possible to estimate the number of users currently in the vicinity of a public display. By connecting several displays, phones can be tracked based on a unique ID such as the Bluetooth MAC address. This raises concerns with regard to the privacy of the persons being tracked and mechanisms are needed to assure their anonymity. Yet, the opportunity to identify a specific phone has the potential to be of increased value for users since it provides a way to only show advertisements which are of personal interest to a specific user.

The information derived from the sensors can be used to improve targeting the content of advertisements by creating a user profile. A system can be designed that learns users' interests and shows related advertisements the next time they pass an outdoor advertisement [1].

BILLBOARD LOG FILE
In the World Wide Web, log files are widely used to estimate the number of visitors of a page. Different types of information such as the origin of a user or the browser used can be stored. This information may not be reliable because of the use of proxies, bots, etc.; a good estimate can still be achieved. By using sensors connected to displays such log files can be created in the real world providing an estimate of the number of passing people. We outline different techniques that can support the creation of such a log file.

Bluetooth
The assessment of Bluetooth MAC addresses in a single location can return the following data:

- Estimation of the *number of visitors* (based on the amount of Bluetooth devices scanned and an estimate of the ratio between spotted devices and total number of people).
- Estimation of the *time spent in the vicinity*.
- *Time profile* (based on the number of visitors at specific points in time). This information can also be used to determine when content should be changed.
- *Unique ID of visitors* (regular visitors, people coming back, and new people can easily be distinguished).
- From the *Bluetooth MAC address* the manufacturer can be derived as well as a guess be made about the model.

Further Sensors
To gather further information, either a single *visual sensor* or a *camera integrated in a poster* can be used to collect visual data. Hence, "counting eyes" and the "time looked at" can be used as a measurement of attention (similar to counting link clicks on the web). Using visual sensor data makes it possible to recognize people (how many, male / female, how dressed, etc.), scenes (group, pair, talking, waiting, etc.), objects (cars, shopping bags, etc.), and activities (eating, drinking coffee, using a mobile device).

Microphones attached to a poster can be used to spot keywords explicitly (e.g., user talks to the advertisement which can react accordingly) or implicitly (conversations taking place in front of the poster can be overheard and advertisements adapted accordingly). Further, microphones can be used to assess scenes thus determining whether a single person (silence), two persons (dialogue) or a group is standing in front of the poster. Similarly, a classification of background noise may be taken into account.

Using both microphones and visual sensors creates severe privacy concerns since scenes are processed in order to act based on the content. Hence, processing the data has to be implemented in a way such that no data are permanently stored and can only be extracted online.

COMPARITIVE ADVERTISING POWER

Measurements derived from data gathered by those sensors are in an absolute sense unreliable due to several reasons. On the user side, not everyone has a Bluetooth-enabled phone so that not all devices are discovered. Additionally, it is not clear whether people look at the poster at all. On the system side, Bluetooth devices can be missed during a scan, or image / audio recognition may miss objects. Also, data may be deliberately ignored or filtered in order to preserve privacy. Hence, we use a comparison of data from several posters in order to extrapolate the data efficiently and overcome this lack of reliability.

Approach

The solution we suggest is the use of a so-called reference poster which is placed at a specific location such as the entrance to a railway station or a shopping mall. Our idea is to equip this poster with all types of sensors included in the other posters. For this reference poster, a detailed user analysis is made using, e.g., existing counting infrastructure (e.g. entrance to subway), expensive and reliable sensors or even manual counting. The result of this analysis is then compared to those of the other posters (e.g. how many Bluetooth MAC addresses can be seen in the reference poster in one hour vs. another poster). Based on the results of this comparison, it is possible to derive an estimate of, for example, how many users really passed the poster.

Application

The data of our approach can be used for different applications including pricing models for advertisements (similar to pay-per-click), determining the update frequency for advertisements, and comparing user profiles.

CLICK STREAM

In the web, a click stream is used to track what consecutive pages a user visits. Click stream data can serve to identify returning visitors as well as the path visitors are taking.

By using statistics from the sensor data as well as a Bluetooth MAC address, we can achieve something similar in the real world, such as tracking the path a user takes along different advertisements. For even more reliable data, this approach could also use image recognition.

Applications examples

One possible application area is showing advertisements related to previous shop visits. An ID scanned during a visit to a shop can be used to later display a matching product once the user is close to a poster. Hence, the moment of change as well as the change frequency of an advertising display can be optimized. Further, a campaign can be created along the user's statistically most likely path. Additionally, it can be assured that users do not see the same advertisement too many times, but on the other hand ensure that a certain brand reappears a certain number of times.

CASE STUDY

In order to evaluate our approach, we equipped an installation of 6 public displays at the University of Münster with Bluetooth scanners and cameras [3]. We use face detection to measure view time for different information items, and Bluetooth scanning to measure trajectories of users [2]. The collected data reveal significant differences between displays, but noise makes it impossible to give absolute measures. Using the concept of comparative advertising power, we are able to link manual evaluations from videos taken by the cameras installed for face detection and thus achieve more accurate viewing time estimations for all displays.

PRIVACY AND USER ACCEPTANCE

Using video and audio recognition in public places raises severe privacy concerns. Hence, in order to support acceptance, it is inevitable to make the users aware of the system or to even give them the opportunity to not being tracked by the system. The system has to be non-deterministic, i.e. people standing next to each other should not be able to figure out that an advertisement is targeted to a specific person. Further, the application should provide a real benefit to the user. This can be achieved by targeting advertisements towards the interests of a user and mixing them with news. In our studies, we also found that there are significant cultural differences regarding privacy and acceptance.

CONCLUSIONS

Nowadays advertisements in physical space provide little opportunity to gather data about their viewers. Our approach provides an easy way of using data freely available such as Bluetooth IDs to gain information about a user. To overcome the lack of reliability of sensing we present an approach of comparative advertising power. This information can be used to improve the user experience by tailoring advertisements and to improve the understanding of the advertising space.

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