Presence Sensing Billboards

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Abstract: The Out-of-Home (OOH) media markets currently rely on a plethora of methods and technologies for measuring their potential or real success. From nationwide interviews over statistical analyses to device based mobility records, each of the OOH markets (in different regions or countries) has chosen its own mixture of measurement efforts in order to provide more or less clear numbers to their clients. In this contribution, we are presenting the *Presence Scanner*, a new and inexpensive technological approach to detecting the presence of people in front of OOH media sites. Based on an array of ultra sonic range finders and equipped with wireless communication capabilities, the Presence Scanner is on its way to resemble a flexible and scalable solution to plug and play activity sensing in (at least) indoor scenarios.

1 Towards Aware Billboards

Out-of-Home (OOH) and ambient media are still representing a substantial part of our daily advertising dosage, with about 10% and 8% of gross contacts, respectively, as of 2007. For instance, City-Light-Posters enjoy increasing popularity within the young and mobile audience. The attentiveness towards OOH media is lower than for most other media, except for radio, but is still rated around 2.8 (on a scale from 1 (low attentiveness) to 6 (high attentiveness) [DFIS08].

However, the OOH market and especially its main shareholders—OOH advertising companies such as EPAMEDIA and JCDecaux—are facing rough times, as they are still struggling with the definition and measurement of *contacts*. Contacts however (or better: the *opportunity to see*, OTS [Kos09a]), are the currency of advertisement and in times of the Internet where views and clicks of advertisement banners are rather easy to count, the measurement methods used in classical advertisement markets such as TV, Radio and OOH have to be reconsidered. The OTS is closely related to the "frequency" of a specific OOH media site: how many OTS/passers-by are there in a certain amount of time (e.g. per hour)?

Pedestrians, cars and public transport users are all among the group of individuals to be considered in OOH media situations. While cars are usually tracked by official authorities and the usage of public transport is known by the public transport companies, pedestrians are harder to grasp (in numbers), as they roam around rather freely. Statistical analyses from data gained in interviews or questionnaires can serve as a powerful and accurate source for media planning, however "real" data, measured at the place of occurrence has a clear potential for higher accuracy and it can even serve for realtime decisions if required.

In this paper we will thus first give an overview on currently used contact definitions for OOH media, motivate our approach for non-cooperative people counting, present different technologies for presence detection in public spaces and provide a detailed view on the Presence Scanner (a cheap and easy to use presence detection device suitable for outdoor usage) and its system architecture. We will also present two application scenarios of the Presence Scanner for the OOH market that are currently under development.

2 Frequency Counting

International OOH research uses mainly three methods for calculating individual related billboard contacts [Sch05]: questionnaires, observations and the usage of existing traffic counting data. Since questionnaires tend to be rather inaccurate, more and more observation based methods are implemented and used for the derivation of contacts [Sch05].

2.1 Plakatwertung Österreich

The Plakatwertung Österreich (PWÖ) is the Austrian implementation of a billboard contacts definition, introduced to the market in 2000 and revised in 2004. It consists of the following criteria [Kos09b]: (1) *site* different sites must be at least 25m apart; multiple billboards are considered a part of the same site if closer than that, (2) *visibility and distance* a billboard situated in parallel to the flow of traffic can be viewed from up to 80 meters distance in an angle of at least 30°, (3) *road distance* the distance is measured from the middle of the road, (4) *billboard direction* with respect to the viewer, from 0° to 90°, in 15° steps, (5) *frequency* based on statistics of the Kuratorium für Verkehrssicherheit (KfV); for roads without available statistics, additional measurements have been conducted, (6) *velocity* based on data of the KfV, including traffic light slowdown and (7) *density* the more billboards on a single site, the higher the devaluation of the site.

The PWÖ classifies the 61,563 billboards in Austria into six classes (A-F; Superstar, Star Plus, Star, Top, Selekt, Standard), based on the Plakatwert (PW) calculated from the criteria above. As of the end of 2008, the EPAMEDIA owns 51.9% of all registered billboards, the Gewista 31,6% and the remainder OOH companies sum up to 16,5% [EPA09].

2.2 Buitenreclame

The Buitenreclame (Netherlands) is based on the national traffic counting (supported by annually 120,000 respondents [Kos09a]), which allows finding out start and end points of the registered routes. Using questionnaires and calculations it is possible to infer the actual paths and thus the contact chance [Sch05]. In order to get better contact numbers, this model is extended with a rating for each billboard site, regarding properties such as the distance to the road and the angle of vision [Kos09a].

2.3 ma Plakat

The ma Plakat is the method of choice in Germany and replaced the Plakat-Media-Analyse (PMA) in 2004 [Arbb]. In 2007 the ma Plakat comprised a computer assisted telephone interview (CATI) part (ma 2007 Plakat CATI) with 21,000 samples and a GPS-based mobility study (ma 2007 Plakat GPS) with 8,600 samples conducted in 24 cities [Arba, HK08]. The CATI part was realized by five institutes in 2007 and cost about EUR 77.- to EUR 84.- per interview in a first phase of the project [Rit07]. The GPS part was realized by test persons who carried a GPS receiver for a period of seven days which stored GPS coordinates every second [HK08].

After injecting (1) *CATI and GPS data* into the required model, additional information is added [HK08]: (2) *weighted data set* demographic information, such as the Mikrozensus, etc. (provides a basis for sub sequential target group evaluations), (3) *frequency atlas* road-based traffic flows/frequencies (allows the calculation of passage values for each individual site), (4) *polygon system* redistributing the empirically recorded mobility data from the 2007 ma Outdoor CATI (form finely designed mobility spaces for the entire area of Germany) and (5) *k-value* site-specific visibility criteria (different types of advertising media and their individual sites to be regarded in a differentiated manner). Finally, *exposure and passage probabilities* are calculated using a statistical method, the event analysis procedure (Kaplan-Meier method), resulting in the visibility-weighted passage exposure per poster site, which is the reporting unit of the ma Plakat.

2.4 Poster Audience Research

The Poster Audience Research (Postar) is the OOH measurement method developed and applied in the UK since 1996. It builds upon the older Outdoor Site Classification and Audience Research (OSCAR) model from 1981 [Kos09c] and breaks up the measurement into four distinct research projects [Posa]: (1) *vehicular & pedestrian traffic counts* vehicle counts for approximately 25,000 locations and data for pedestrians are put through a neural network program to provide up-to-date traffic estimates [Posc], (2) *visibility study* realized using infrared eye tracking hardware on users that don't know they are part of a study concerning posters [Pose], (3) *travel survey* individuals are interviewed using a computer aided personal interview (CAPI) technique [Posd][1] and (4) *panel audit* each poster site is analyzed (photographs and up to 254 separate measurements are taken) to determine its particular characteristics [Posb].

[1] The overall opinion of the project partners is that GPS could be a good technology for travel data collection, but some problems need to be addressed: drops in the satellite fix and data conversion. Another idea would be not to rely solely on GPS but use other recording methods as a secondary source of information [Bea07]. Also, it was harder (read: impossible) to find respondents for the GPS based survey, even though the incentive was increased from the usual GBP 20.- to 40.-, so a panel was used to find respondents [Kal07].

2.5 Swiss Poster Research Plus

The Swiss Poster Research Plus AG (SPR+) uses GPS traces of people to calculate billboard contact opportunities. The following steps are taken in the process from raw data to a media planning software for potential customers: GPS data collection → paths and tracks → data validation (GIS data) → individualization (site specific data: buildings, visibility) → passages and contacts → modeling and extrapolation (site specific data, mobility data, infrastructure data) → planning tool → customers [Hof08]. The final OTS is calculated by taking some site specific factors into account. In order to get reliable data for e.g. the Zürich area, 1,800 measurement weeks are required.

2.6 Mediawatch

The Mediawatch is a Single-Source-Multimedia-Measurement-Device in the form of a digital wrist watch, currently in its fifth generation [Hac08]. It can be used to measure radio, TV, print and OOH consumption and was developed in cooperation with over 16 companies, institutions and four universities and federal institutes of technology [GfK09]. The functional principle is very simple: an embedded microphones is activated up to six times a minute for four seconds and records audio, which sums up to approx. 12,000 Bytes. Using a data reduction algorithm, the captured audio is converted to a 100 Bytes audio footprint that is stored on the watch. In the data reduction step it is also guaranteed that the original audio sample cannot be restored, which is important regarding data protection and privacy aspects [GfK09]. The maximum operating time is four weeks [Hac08]. In order to infer media contacts, the recorded footprints are matched against a central data server that collected continuous footprints of all relevant media [GfK09, Hac08]. The Mediawatch can even receive radio frequency signals thus it can be used for measuring OOH media OTSs as well as cinema and shopping mall visits [Hac08]. However, this requires the billboards or other points of interests to be equipped with small transmitters, that need to be powered [Sch05].

3 Presence Detection in Public Urban Areas

Using interviews to generate traffic information about pedestrians is a rather tedious and costly task if conducted on a regular base and with a large sample. Technologies such as the Mediawatch or the SPR+ GPS tracking method provide a cheaper (in the long run) and more reliable (in interviews there is no guarantee that the answers given by the test persons are correct) way of getting the required mobility information. However, it is required that the users carry some kind of technology (a “user token”) with them, leading to two issues: (1) only parts of the citizens are considered and (2) participants have to be found. In this classification, also Bluetooth MAC address sniffing falls into the category of user token based approaches, it is therefore not considered any further (see below).

We believe that such user token based techniques are one answer to gather information about billboard passers-by (and many additional scenarios are possible by relying on these user tokens); still, techniques that don't require the passers-by to actively participate in the counting process unleash another potential: that of the big masses. This "non-cooperative" approach is not not only able to respect privacy issues (as long as it's not based on camera systems), because passers-by don't have a known ID in the system, but could even be easier to setup and maintain if the right usage scenarios and technology decisions are made: only selected OOH media sites need to be equipped with some kind of technology instead of lots of probands. Additionally, the user-token-less counting sensors could be an enabling technology for device free interactive installations (be it implicit or explicit). This leads to another advantage of non-cooperative solutions: realtime capability. Statistical approaches (such as user token based approaches, traffic counting, etc.) can only give an estimate of the current situation with a certain probability, while devices mounted on-site have a chance to provide "real" realtime data to be used either locally (implicit advertisement adaption, user interaction) or more globally for realtime media planning decisions, as well as realtime billing.

Based on the different methods described in Sec. 2, we believe that such detailed data could even help making better media planning decisions now, but it will be a necessary part of tomorrows OOH advertisements. Currently, static OOH media is exchanged every 10 to 14 days, degrading detailed frequency information to non-significant supplemental information. But with the advent of digital signage products, OOH media start being able to react on situations in the blink of an eye. Detailed data, such as activity and presence patterns in front of billboards and screens, could be the key information for delivering messages to the target groups with much better efficiency.

A number of technologies exists for detecting the presence of people in a certain area, ranging from very cheap to extraordinarily expensive, from extremely small to huge. The following list gives an overview of different technologies and their main features. Thereafter an informative ranking of the different technologies with respect to the purpose of detecting and counting people in front of public displays is given.

Laser Ranger Finders: Laser range finders provide extremely detailed distance measurement resolution ranging from sub-inch to several hundred meters distance. Miniaturized sensors fit into handheld devices and can measure distances up to approx. 100m with a power consumption of 1mW (for the laser module) [Min, TEM]. In public settings, laser range finders might not be a good choice because their usage of laser light could lead to eye injuries, thus lowering citizen acceptance. Multiple sensors need to be mounted in order to gather detailed information about the movement of people, except when using scanning laser range finders that can observe a certain field of view. Such sensors are unfortunately more bulky and more expensive than the fixed directional sensors, with dimensions around 80x80x80mm^3 [Acr].

Optical Range Finders: Optical range finders emit light that is than detected using a photo sensor; based on the time-of-flight for each pixel of the sensor a 2-dimensional depth image can be generated. The quality of this kind of sensor is very high (e.g. featuring a resolution of 176x144 pixels and a horizontal field of view of 43.6°), the package size is around 65x65x68mm^3. Sensors are usually designed for indoor usage and support a scanning distance of up to 5m [MES09].

Passive Infrared: Passive infrared (PIR) sensors can be used to detect the presence of people nearby at a rather cheap price with a small footprint. The detection range for miniaturized modules can be as far as 10m, with a field of view of 360°[IR-06]. Motion detectors are binary sensors, i.e. they can say, that there is a human, but they cannot say where and in what distance he/she is.

Radar: Radar allows detecting the distance and movement speed of objects up to several kilometers away. In the short range sector, improvements with regards to the size of radar modules have been accomplished, enabling modules in the size of 60x45x20mm^3 detecting objects up to 30m distance [KGH$^+$05].

Ultra Sonic Range Finders: Ultra sonic range finders work similar to radar range finders, but make use of acoustic waves instead of electromagnetic waves. Due to the difference in speed (speed of light vs. speed of sound) no highly precise electronic components need to be deployed, resulting in cheaper circuits. Ultra sonic sensors can cover distances up to 18m [Fut].

Computer Vision: Camera based presence detection and counting systems provide very flexible and accurate readings at the cost of high data rates and consequently a larger amount of computing power. For the purpose of public space observation, cameras face legitimately harsh opposition from privacy advocates, which is the main reason why we ruled out this technology for our purposes. Micro cameras can be as small as 30x30x30mm^3 while providing high quality images at frame rates as high as 80fps.

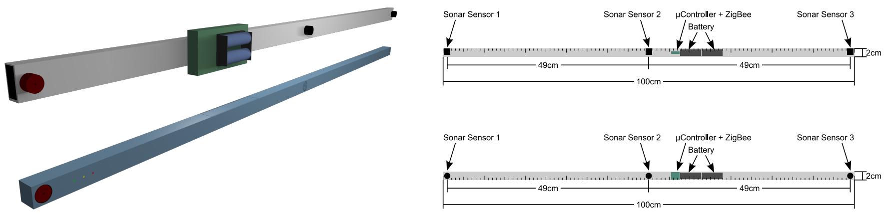
Photo Electric Sensors: Photo electric relays ("light barriers") are a very cheap, reliable and technically robust solution, but they require a slightly more complex setup: light source and detector or reflector need to be aligned correctly, if there is a spot to mount them at all. In outdoor/urban scenarios there is very often no "opposite side" or if there is one it will most probably be owned by a third party, complicating the setup (and maintenance) process. Miniaturized light barriers can cover distances up to 14m [Dis09a, Dis09b].

For our purpose of building a cheap, small and outdoor capable sensor system for presence detection and people counting we ruled out camera based systems for reasons of user acceptance and privacy concerns, even though good progress has been made in detecting and counting people using camera based systems [HHD99, SGMR01, YnG03, RF03, SBGPO08]. With regards to the material cost radar and optical range finders were not a choice. Laser range finders were excluded because of possible eye injuries with laser light (especially in public/crowded areas). Light barriers are not practicable in terms of installation, as we envisioned a system that is capable of true plug and play, but light barriers need the installation of a reflector or the detector opposite to the light source—this introduces additional complexity and might prove impossible in many outdoor scenarios.

That left PIR and ultra sonic range finders in the shortlist. Since pricing and module size is about the same for both technologies we decided to use ultra sonic, because it provides more detailed information (distance of objects) allowing finer grained application response as well as better people counting capabilities through path estimation and plausibility checks (e.g. walking speeds).

4 Presence Scanner

With the Presence Scanner we started implementing a self-contained, scalable, wireless presence detection device, prepared for plug and play usage. One Presence Scanner comprises three ultra sonic range finders, arranged in line with a distance of 49cm from the outer sensors to the center one, resulting in a bar with 1m length. The first prototype, realized based on a cable duct, has a cross section of $16x30mm^2$ and a crude ZigBee enabled radio platform of another $100x50x30mm^3$ attached to it (cf. Fig. 1a.top). We are currently planning a second generation made of a custom designed plastic housing ($1000x20x20mm^3$) incorporating all required electronics, running on two exchangeable AA batteries (cf. Fig. 1a.bottom and Fig. 1b). The sensor beam pattern of the Presence Scanner is depicted in Fig. 2a, the raw distance measurements over a period of three minutes are shown in Fig. 2b.

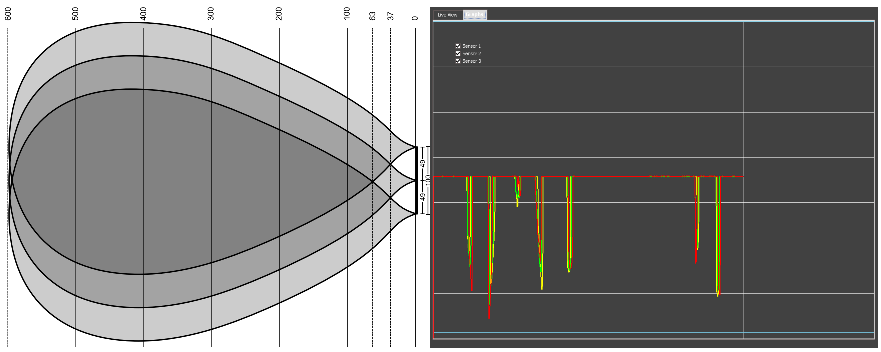


(a) (b)

Figure 1: (a) an early prototype (top) and the envisioned Presence Scanner design (bottom). Each of them is 1m wide and features three ultra sonic sensors with 49cm distance to each other as well as an integrated microcontroller and wireless communication chip. (b) detailed view on the envisioned indoor design (including a metering rule texture for "analogue" usage).

The ultra sonic range finders in use are MaxBotix LV-EZ1. In order to avoid interferences between the three senors, they are enabled sequentially. The built-in support for daisy chaining these sensors didn't work flawlessly, so the daisy chaining was realized in software on the microcontroller. The delay between the activation of each of the sensors depends on the application scenario: the time increases with larger distances to measure (because ultra sonic range finders are based on time of flight measurements) and with the amount of resonance of the probing audio signal, i.e. the properties of the acoustic environment.

We empirically identified the following values as a robust setting for indoor usage (opposite wall distance >8m, consisting of glass; glossy tiled floor with lots of reflections): (1) the delay between sensor activation was set to 160ms, (2) after all three sensors we added



(a) (b)

Figure 2: (a) the approximate sensor beam pattern of the Presence Scanner (adapted from [Max07], numbers in cm) and (b) raw sample measurements of the three sensors of the Presence Scanner over a period of three minutes in an indoor setting (maximum distance 358cm). The distance between two white lines equals 100cm and reaches from 0cm (bottom) to 700cm (top). The seven clearly visible peaks depict bypassing from different directions in different angles and distances.

another 20ms delay to make one cycle take 500ms for reading all three ultra sonic sensors sequentially (cf. Fig. 3.bottom). In another indoor setting, with the opposite wall being closer than 2m, the inter-sensor delay was set to 50ms and no "final calm down" delay was required for getting stable readings from the Presence Scanner (cf. Fig. 3.top).

4.1 Modularity and Scalability

Our decision to go wireless with the Presence Scanner was partly driven by improving the scalability of the system. Multiple Presence Scanners could be mounted close to each other, extending the observation area or taking into account different observation angles or heights. The main issue in deploying multiple Presence Scanners in close distance is the potential interferences with other Presence Scanners, thus the ultra sonic sensor activation needs to be synchronized. The simplest solution to this issue is activating each Presence Scanner sequentially, as it is done within a single Presence Scanner (cf. Fig. 4). This daisy chaining of the Presence Scanners results in a rather poor performance, with a sampling rate of 0.69Hz when using three Presence Scanners. Higher sampling rates can be achieved by allowing distant sensors to be activated simultaneously, either on a Presence Scanner granularity (less performance) or on a single sensor granularity (better performance).

But how to decide if two sensors are far enough from each other? The main factor is the maximum distance to be measured by the sensors: two sensors must be placed in a distance of at least double the maximum expected distance, because in this case the audio signal of one sensor will arrive at the other sensor later than the signal sent out by the other sensor

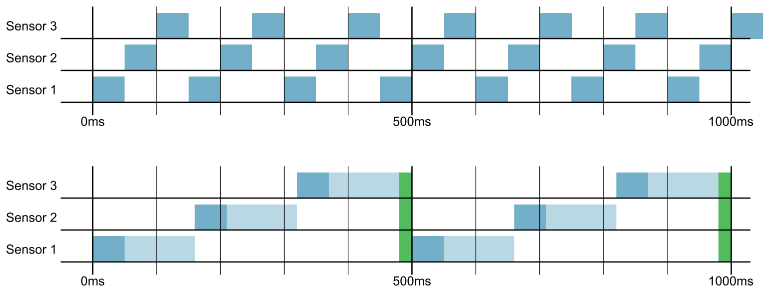


Figure 3: Timing issues in the Presence Scanner: (top) indoor setting with low maximum distance (<2m), (bottom) indoor setting for echoic environments. The darker blue resembles the minimum delay (for re-activating the same sensor again) as of the sensor specification, the lighter blue depicts the safety delay before activating a new sensor, while the green bar represents the artificial "synchronization" delay at the end of one cycle (to add up to 500ms total cycle time).

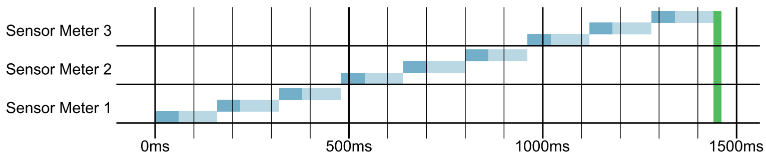


Figure 4: Daisy chaining multiple Presence Scanners to avoid interferences. After one complete cycle 20ms of calm down delay are inserted. The delay between activation of each sensor is taken from the indoor scenario with the higher amount of echoes (cf. Fig. 3.bottom).

itself. In the scenario depicted in Fig. 5 the maximum distance to be measured is 2.4m resulting in a minimum distance of 4.8m between two sensors to avoid erroneous readings. Two consecutive readings of different sensors are allowed every 80ms (this value should be sufficient to let the echoes pass off). The result of this setup in which 2 pairs of sensors are far enough from each other (out of a total of 8 Presence Scanners, corresponding to 24 sensors) is a very poor (and almost neglectable) sampling rate improvement from 0.52Hz to 0.57Hz per sensor.

4.2 Counting Passers-by

Two counting algorithms have been implemented so far, both of them being a work in progress: (1) detect on leave and (2) live evaluation. Currently, we cannot deliver any detailed data on the accuracy of the algorithms, as we are still exploring these and other ways to reliably count passers-by.

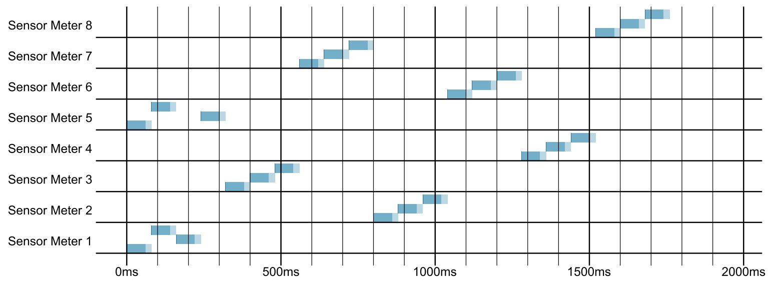


Figure 5: In this setting, sensors 1 and 3 of Presence Scanners 1 and 5 are far enough from each other in order to be operated simultaneously. All other sensors need to be operated sequentially. This corresponds to a sampling rate of 0.57Hz compared to 0.52Hz in pure daisy chaining mode.

4.2.1 Detect on Leave

Useful for detecting people passing by the Presence Scanner in parallel. The algorithm is triggered on a rising edge of one of the outer sensors—such an event can be interpreted as "somebody just left the sensing area of a sensor". In that case, the history of the other two sensors is analyzed to find out whether a person could just have walked by them, sequentially. Assuming a walking speed of 0.5-1.7m/s (≙1.8-6.12km/h) and regarding the distance of the sensors of 49cm, the history of the last 0.29-0.98s is taken into account for the center sensor and the last 0.58-1.96s for the other outer sensor. If there is a matching measurement (regarding both the time it was read and the distance measured) on both sensors, the people counter is increased by one. Additionally, the direction the person was walking in (left or right) is known. By evaluating the distances measured by the three sensors an estimation of the angle in which a person was passing by can be inferred. This algorithm is a single user algorithm with no support for multiple people passing by or stopping in front of the Presence Scanner.

4.2.2 Live Evaluation

The live evaluation algorithm is a more sophisticated approach to the detection and counting of passers-by. For each sensor reading, a comparison to the state at the last reading is conducted (considering the readings of all three sensors of a Presence Scanner). That way a virtual passer-by (VPB) is created for each sensor reading that couldn't be a follow-up of another VPB (regarding the same constraints like in the previously discussed approach). Existing VPBs are repositioned using the sensor readings and a possible path and speed is calculated. This approach is much more flexible, especially when taking into account several Presence Scanners and combining their readings for VPB creation and tracing. Unfortunately, the current state of implementation is far from delivering reliable results, but we believe that it has enough potential for good results and even—to some extent—multi user support.

5 Conclusion

We presented a new and highly scalable plug and play device for outdoor people counting, the Presence Scanner, that can be mounted on any billboard and provides the number of people passing by as well as real time interaction possibilities (see Sec. 5.2). Currently, a storage and processing unit needs to be attached to the Presence Scanner(s), as the on-chip memory is too low for long-term storage. We have yet to improve the people counting algorithms and inter-device communication, synchronization and negotiation, but first steps have been taken. The solution so far is low cost (less than EUR 200.- for one Presence Scanner when relying on the currently used components) and can be made cheaper when changing to other components or producing in higher volumes. With the Presence Scanner, interactive OOH advertising is gaining another tool for simple installations, especially for short range implicit interaction (cf. Fig. 6). At the same time, the OOH market receives a new tool for evaluating billboard sites that requires no explicit user participation and respects user privacy concerns by sensing distance values only—no sensible data that could raise privacy concerns is sensed or inferred.

We believe our system is suitable for indoor and outdoor usage. Indoor usage could be validated by our lab experiments: as depicted in Fig. 2b, the measured data is relatively stable and allows algorithms to rely on this low noise data. Outdoor usage is just assumed, as we haven't extensively tested the Presence Scanner in outdoor scenarios, yet. There might be problems with the stability of the sensor data due to environmental noise introduced by machines, cars (parking assistant systems), etc.

5.1 Drawbacks

Compared to some of the methods presented in Sec. 2, our approach has considerable drawbacks: (1) it is not able to identify people, i.e. it is impossible to generate accurate traces of people through the city or find out that a person would pass by a certain site every working day at a certain time. (2) due to the technology used and the shape of the Presence Scanner, it can only detect objects up to a distance of 7m. (3) if an algorithm for counting cars would be implemented it would not be possible to count the number of passengers residing in the cars. (4) the same holds true for public transport.

Many more drawbacks of our approach could be found, however when thinking of the Presence Scanner as "one of the tools" that make up the overall view on frequency counting, we believe it could play a considerable role, because it would even enable value added services such as *interactive advertising* to the frequency counting functionality (cf. Fig. 6). Also, the Presence Scanner was not designed to deliver an answer to the questions described in any of the previously stated drawbacks. Our goal was to implement a system that would be able to count pedestrian passers-by. When we decided to use ultra sonic range finders, we knew that this would introduce drawbacks such as restricted distance scanning, occlusions, non-identification, etc. For our purpose, this was acceptable.

5.2 Outlook

We are currently implementing and incrementally enhancing the counting algorithm in order to get reliable data, while at the same time a truly embedded system is designed and a wireless negotiation protocol is implemented. Our goal is an embedded system to be presumably bought in a hardware store to be used in a plug and play manner.

The performance of the counting algorithm will be tested in a field study that is currently in preparation: a sensor bar is mounted on a real outdoor advertising billboard or "City Light" and Presence Scanner counts are compared to manual counts as well as other techniques such as Bluetooth MAC address sniffing.

In another implementation we are envisioning an interactive ad for a City Light, based on a Presence Scanner embedded therein and some of the lighting coupled to the sensors, such that only parts of the ad will be illuminated, based on the sensed distances of the three sensors (cf. Fig. 6). For this installation, a different layout of the sensors (other than lined up in parallel) is intended, with all three sensors placed close to each other and pointing in different directions—the angle between two sensor center axis is 50°, resulting in an observation area of almost 180°. Our intention with this installation is to find out if there is any improvement in recall values in comparison to "normal" ads and to test the user acceptance of this technology. This scenario is based on observations of previously implemented creative city light ads that would light up various areas of the poster using a constant loop. Multiple users would simply light up more areas at the same time, therefore no negative impact on the user experience or presentation of the product is expected.

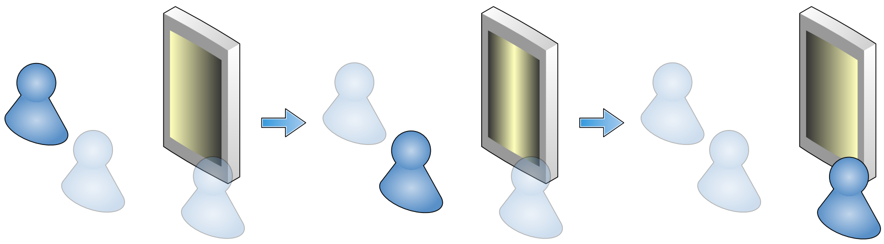


Figure 6: Future development: only parts of the advertisement are illuminated, depending on the location of the viewer. The distance of the viewer could be used to control various light properties.

6 Acknowledgments

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