The Real Game CHANGER?

The growth of the Location Based Services (LBS) market is being driven by the widespread use of tablets and smartphones. The advent of new generation wearable devices, such as Google Glass, will heavily leverage on localisation as one of the most relevant feature. Analysts predict that the key areas driving revenues for indoor LBS will be navigation, localised searches and location-driven advertising.

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In the retail domain, the impact of indoor location technologies will be very significant. According to Berg Insight, the Location-Based Advertisement and Marketing (LBA) spending in 2011 was already €192 million (or 5.0% of total mobile advertising spending). However, real-time LBA will grow at a compound rate of 90.9%, rising to €4.9 billion in 2016 or 28.3% of all mobile advertising and marketing. A 2013 report from xAd has highlighted that in the US, 95% of advertising companies are using some form of location-based advertisement. Precise geo-location is among the top requirements, with a growth in triple figures being registered on a yearly basis.

This growth is to be framed within the overall (i.e., outdoor and indoor) predicted growth of the LBS market. This, according to Pyramid Research, is expected to grow from $2.8 billion in 2010 to $10.3 billion in 2015 at the global level. According to ABI Research, this is not only a trend to be found in Europe and US but it has been witnessed in the BRICS countries with a substantial rise of LBS, found especially in the retail, mobile analytics and mobile advertisement market, whose figures will exceed $6 billion by 2017.

The importance of being able to localise with high accuracy and in real time people, and customers, within the retail domain however, is set to deeply affect retail business. Indoor LBS in fact are set to become a game changer in the way shop owners and customers behave.

On one hand, indoor location technologies can be clearly used to deliver accurate indoor navigation features, delivering thereby a better shopping experience. On the other hand, the use of indoor location technologies will let shop owners analyse the behaviour of their customers within their retail space allowing them to extract key spatio-temporal patterns. Analysis of movements can be used to identify hot and cold areas (areas where customers stay or do not stay over time), or to extract objective metrics related to customers' preferences for instance leveraging on the time a customer stands in front of a given product. The capability of leveraging on the position of the users within

retail spaces (e.g. within malls or shops) can allow shops engaging them through marketing actions that are closely tightened to their preferences and social network profiles.

Indoor navigation

The first natural consequence of the availability of indoor location technologies within the retail world is associated to indoor navigation features. Examples could be development of mobile applications that, based on the users' preferences or shopping requirements, can guide them through the retail space through optimised routing. Next-generation navigation app could, for instance, be tuned for minimum navigation time, needed for instance when rushing to buy few items within a large supermarket, or to maximise shopping experience .

While online shopping has essentially moved people away from real world retail spaces in favour of their virtual counterpart, indoor navigation technologies could help reverse this trend by creating applications capable of maximising the gratification of physically visiting a retail space, yet with the convenience of being guided through it in an efficient way.

Analysis of customer behaviour

In the retail world, the overall layout of the store, the distribution of aisles and furniture, the location of various products within the shop is based on the potential interest that products can draw from customers. Being able to understand the way customers move within the retail space is essential to maximise the selling potential of the displays. Traditionally, the analysis of movements of people within the retail space has been done empirically, based on the experience of marketing managers. Being able to provide metrics, including footfall levels, movement patterns and queue analytics, can be used by store managers to optimise the placement of goods, to measure the effectiveness of store layouts and to improve staff management. This particular activity can benefit from the availability of indoor technology capable to track, with high accuracy and in real time, the position of customers within the retail space over time. Several approaches have been proposed based on the use of tracking of devices, for instance smartphones, or tags (which can be embedded in shopping carts and shopping baskets), as well as on the use of cameras. All approaches present pros and cons, and a tailor mix is required for most retail companies.

Another important source of data is related to the interactions of customers with products. This can enrich the analysis of movement patterns to provide a deeper understanding of the whole purchase funnel, helping store and marketing managers to optimise their commercial offer.

Key enabling technologies

➤***Cameras:*** An innovative approach relies on the use of computer vision techniques to extract, from images captured in real-time from 360-degree cameras mounted on the ceiling, the position and the movement of people indoors with a few centimetre precision (Fig. 1).

It is important to highlight, that the system is privacy-savvy because the video flow is never visible from any operator or staff. Instead, the video stream is directly processed by dedicated software that, through dedicated computer vision algorithms, extracts the position of the various users. For obvious privacy reasons, once the position of people is identified, the original image is deleted. In addition, no face recognition is ever performed. In other words, the system deals with various people within the scene in a completely anonymous way. While the system is able to understand that a number of users are moving within the indoor space, it is never ever aware of "who" these users really are.

The information on the movement of the different users is further processed to remove inconsistencies, typically when two persons are partially occluding each other. Information on the various people present within the retail space is time-stamped and stored within a database.

An analytics engine can be then used to derive analytics useful for the marketing staff. As visible in Fig. 2, marketing staff can dynamically create areas of interest, which can be used to derive spatio-temporal indicators on how long people have stayed within each area. The analysis can also be used to perform sophisticated geofencing tasks, like to identify where people statistically move from or to, within a shop, or to count how many people get close to a given part of the retail space.

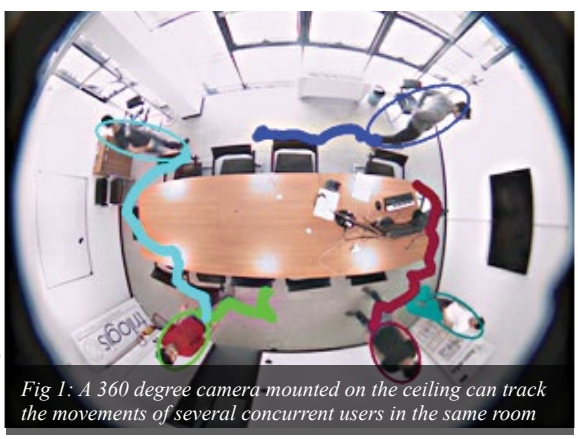

Fig 1: A 360 degree camera mounted on the ceiling can track the movements of several concurrent users in the same room

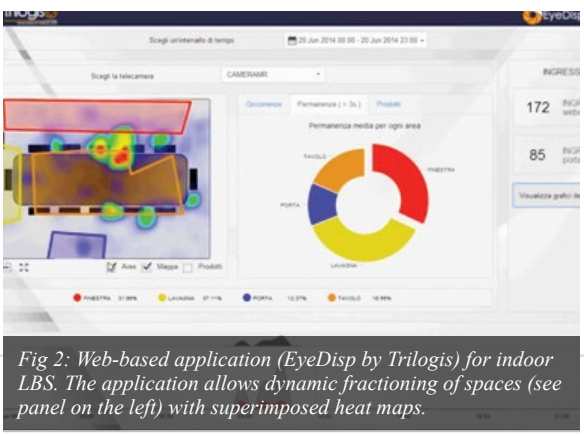

Fig 2: Web-based application (EyeDisp by Trilogis) for indoor LBS. The application allows dynamic fractioning of spaces (see panel on the left) with superimposed heat maps.

It is thus possible to identify how many passers-by have entered a shop and — in turn — how many have moved down to each of the areas or unit of the shop. Most notably, since indoor location data are constantly saved, the analysis can also be performed by changing areas or sections ex-post. An easy-to-use interface allows performing all these tasks in a very simple manner without any specific analytics skills.

The impact of such an approach at the retail level is potentially enormous. By having analytic indicators of spatio-temporal behaviours of customers, it becomes possible to assess the impact of new showcase introduced within the shop. The impact of new layout can be assessed analytically, so can be the location of so-called "hot" areas, where the customers spend most of their time.

In addition, spatio-temporal analysis can be further integrated with sales figures. As illustrated in Fig. 3, it becomes possible to compare hot areas against position of "hot" products, i.e. products with higher marketing interest. These are illustrated in the figure by circles whose size identifies the number of sold units while the colour represents the profitability.

By dealing with (indoor) geographical data with an intrinsic time-changing nature, it becomes possible to perform comparisons between figures at different times. For instance, as illustrated in Fig. 4, shop owners or marketing managers can compare distribution of movements of their customers between, before and after a change to the layout of the shop.

➤ ***Tags and smartphones:*** Wireless technologies can be used for tracking objects (typically shopping carts and baskets) and people. As an example, WiFi is becoming popular in brick and mortar shops to track WiFi-enabled mobile devices, Bluetooth low energy (BLE), either in the form of iBeacons or of tags represents an appealing alternative, which is currently gaining traction in the market.

If compared with camera-based approaches, typically the use of tags and/or smartphones provides lower coverage. Yet, it presents the advantage that it enables end-to-end analysis. Indeed, one of the most complex problems of computer vision is that of re-identification, which makes it hard to reconcile images from different cameras in such a way to reconstruct the movement pattern of shoppers. This is particularly important for grocery stores, where the movement pattern is a key marketing metric.

As an example, by equipping shopping carts and shopping baskets with BLE-compatible tags it is possible to reconstruct end-to-end movement patterns of shoppers, together with footfall levels and dwell times for the various areas of a store.

➤ ***Targeted advertising:*** While analytics represent interesting business opportunities, it represents only one side of the coin. By being able to measure accurately the position of users within a shopping area, it indeed becomes possible to deliver her/him targeted advertising, where the ads and offer reflect both the position of the user (e.g., discount on nearby products) as well as her/his interests.

From the technology standpoint, this requires linking the positioning data (which can be acquired, as we saw, with cameras, tags etc.) to a personal display. In case the tracking device is the smartphone itself, this comes for free as the smartphone (through a proper app) can be used to display ads and offers as well. In the case of a tag embedded in the shopping cart, a display could be added to the shopping cart itself. In the case of cameras, additional technical means need to be deployed.

It is worth remarking that, as we move from anonymous tracking of people to personalised LBA, privacy issues need to be considered. In this case indeed the information collected could — potentially — make customers 'identifiable', which in turn means that the data collected is to be considered, in legal jargon, personal information and treated according to relevant regulations and policies. The application of privacy-by-design approaches is going to become a key enabler for ensuring LBA and LBS will meet their full potential.

References

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Fig 3: Integration of location data with sales figures.

Fig 4: Comparisons of customers' spatial behaviours between two different