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Survey on Monitoring Crowd Conditions using Mobile Consumer Devices

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Abstract: Presenting a systematic study and optimization of crowd monitoring methods based on tracking consumer devices with activated Wi-Fi or Bluetooth interfaces using stationary scanners with directional antennas. Analysing crowd with the help of Wi-Fi and Bluetooth is necessary as they do not need the corporation of audience present in the event or place. Monitoring without the need of audience places a major role in providing and maintaining security at mass events or in places with huge human crowd. Analysis of RF signals is a well-known technique for human activity monitoring. We use a raspberry pi to scan the surrounding for the devices of audience and push the data into system for data processing and after data processing we produce a heatmap and timeline for proper analysis of an individual based on requirements.

Keywords: Wireless communication, Wi-Fi, RF signals, Features from Accelerated Segment Test (FAST)

I. INTRODUCTION

Analysis of RF signals is a well-known technique for human activity monitoring. In general, we distinguish three types of approaches (which may be used in isolation or in combination). First are systems where user's mobile devices scan the environment for signals from stationary beacons such as for example Wi-Fi access points or Bluetooth iBeacons. This is a basis for a whole range of indoor positioning systems (see related work). Second are systems where user's mobile devices are used to detect the presence of other mobile devices. This approach has been widely used especially for the tracing of social interactions. Third, we have stationary scanners detecting, counting, and tracking mobile beacons carried by the users. Such mobile beacons can either be dedicated devices (e.g. www.gimbal.com) or the Wi-Fi or Bluetooth interfaces of standard mobile devices such as smartphones or smartwatches. In this paper we focus on he later. Specifically, we use carefully placed stationary Wi-Fi and Bluetooth scanners with highly directional antennas to monitor crowd conditions during large scale public events. It is a systematic study and optimization of crowd monitoring methods using stationary scanners to track consumer devices with activated Wi-Fi/Bluetooth interfaces on a large, real life data set that includes extensive video ground truth.

II. RELATED SURVEY

There is need for event organizers and emergency response personnel to detect emerging, potentially critical crowd situation at an early stage during city wide mass gatherings. To improve pedestrians' safety, much research has been devoted to understand crowd behaviour and to identify critical crowd condition by conducting lab experiments and evaluating empirical data from real mass gatherings. To locate a particular person, they have used the person's mobile as most of the mobile phones are situation and location aware. Methods like GPS positioning and Wi-Fi/GSM-fingerprinting are used. GPS location is regularly sampled with a frequency of 1Hz on the device and periodically sent to our servers. App offers users full control over shared data and at any time, data recording can be disabled. They provide a heat map visualizations that have been used in different application to convey various types of information [1].

A investigation using smartphone Wi-Fi signals to estimate the amount of time a person spends in the queue. This is common in many business areas such as retail stores, airports and theme parks. It extracts unique features embedded in the signal traces to infer the critical time points when a person reaches the head of the queue and finishes service, and from these inferences we derive a person's waiting and service times. We find that the important periods of a human queue that are separated by three critical time points namely Beginning of Service (BoS), Leaving Point (LP) and End of Leaving (EoL). Beginning of Service (BoS) means the time at which the person enter the queue. Leaving Point (LP) means the time

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at which the service is done. End of Leaving (EoL) means the time at which the persons leaves the queue. By deducing these three time points, system is able to track the important queue time periods including waiting, service and leaving periods[2].

The foundation of Bluetooth based crowd density sensing technique is based on the general observation that many people have the Bluetooth transceivers of their mobile phone in the discoverable mode as default setting. As observed that most discoverable Bluetooth devices are smartphones and cell phones mostly manufactured by Samsung, Nokia and Sony Ericsson. An obvious way to estimate crowd density is to perform a scan for discoverable devices and assume that the number of devices it returns is an indication of the number of people in the vicinity defined by Bluetooth range (typically around 10m). Unfortunately, this simple approach contains a number of problems. Firstly, there is the issue of sufficient statistics. With the scan limited to a radius of about 10m (approximately a circle with $300m^2$ area) anything between a few and a few hundred people can be within range. While in a dense crowd with a few hundred people we may get a representative sample, in less crowded areas we are likely to see very strong variations between samples. Secondly, there is the question of signal attenuation. At 2.4GHz (which is the transmission frequency of Bluetooth) the human body has a high absorption coefficient. This means that in a dense crowd (where we would expect to have good statistics) the effective scan range is reduced and therefore ”falsifying” the results. Finally, we have to consider cultural factors. This means that the average number of people carrying a discoverable Bluetooth device may significantly vary depending on who the persons in the crowd are. This acquired accuracy of 75.3% for estimating the correct crowd density considering all the noises and the interferences [3].

Crowd density analysis is a crucial component in visual surveillance mainly for security monitoring. This approach consists of generating fully automatic and crowd density maps using local features as an observation of a probabilistic crowd function. The automatic monitoring could be used to detect potential risk and to prevent overcrowd. To prevent such mortal accidents and for safety control, crowd density estimation could be used. In the simplest form, the used crowd density measures could be the number of persons or the level of the crowd. These forms of crowd density analysis (i.e. people counting or crowd level classification) have the limitation of giving a Global information for the entire image and discarding local information about the crowd. One of the key aspects of crowd density measurements is crowd feature extraction. Under the assumption that regions of low density crowd tend to present less dense local features compared to a high-density crowd, They have used local feature points as a description of the crowd by relating dense or sparse local features to the crowd size. The extracted Features from Accelerated Segment Test (FAST). FAST is proposed for corner detection in a fast and a reliable way. The reason behind applying FAST as local features for crowd measurement is its ability to find small regions which are outstandingly different from their surrounding pixels. This approach for crowd density map estimation is evaluated within challenging crowd scenes from multiple video datasets. Crowd density estimation has emerged as a major component for crowd monitoring and management in visual surveillance domain [4].

Tracking the crowd at mass events needs real time data of people. By observing people and gathering the data in the desired context, more realistic tracking can be achieved. This method works by scanning at different locations with the help of Wi-Fi interface on visitors object. This method can be implemented using a low cost Raspberry Pi device. Wi-Fi is a local area wireless technology .It allows connecting to the Internet using 2.4 GHz UHF and 5 GHz SHF radio waves. The access point has a range of about 20 meters indoors and a more range for outdoors. By using multiple overlapping access points Hotspot coverage can be increased up to several square kilometers. The size of Wi-Fi USB adapter depends on the power requirement. Wi-Fi provides service in businesses, private homes as well as in public spaces where Wi-Fi setup is configured for free of cost or charged, used to access Organizations and businesses, such as restaurants, airports and hotels. Sometimes some shops or hotels provides free use of hotspots to attract the customers. Connect the USB Wi-Fi adapter to the USB port of the Raspberry Pi. Then Power up the Raspberry Pi. It comes with a wired network only, adding a Wi-Fi on Raspberry Pi takes little effort and fewer expenses. Here a compatible Wi-Fi dongle is needed. After analysis above performed, it is important to mention that Raspberry Pi is a small independent computer. It has a very large working memory (many other sensor nodes do not have). It has expandable memory to store the data. It operates at speeds from 700 MHz to 1000 MHz. It allows expansion and communication with network devices over a LAN adapter. The Raspberry Pi comes with a lot of nice things, but it also lacks some useful features. It does not have a real-time clock (RTC) with a backup battery. It doesn’t have built-in an Analog to Digital converter. External component must be used for AD conversion. It does not support Bluetooth or Wi-Fi out of the box but these supports can be added by USB dongles. It does not have a built in analog to digital converter, external components must be used to AD conversions. To further increase

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location determination precision, the RSSI (Received signal strength indication) value which indicates the received signal strength for a received 802.11 packet could in theory be used. From this value, estimation could be made on the distance between the detector and the device sending out the packet. However, empirical tests have shown that the RSSI value is of little use in crowded environments containing a high amount of electronic devices and people due to severe fluctuations and noise in the data sets. Because of these environmental factors, the RSSI value is currently not used in the detection mechanism [5].

III. CONCLUSION

After referring the project related research paper's, we understand the need for the system to understand and control the crowd behavior. The present latest system contains only the generation of heat map with Wi-fi interface only and there is old system which operates with respect to Bluetooth. These systems have their own disadvantages like Bluetooth system works only if the devices Bluetooth is made discoverable and the range of 10m. Wi-Fi system only generates the heat map or spatial ratio but does not allow for to track a particular device and doesn't allow the system to keep record of the movement of the device.

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