A Method for Correlating to a Person His Phone Number

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Abstract—**This paper was originally submitted to Xinova, LLC as a response to a Request for Invention (RFI) on new event monitoring methods. In this paper, a method to correlate a person to his phone number is proposed.**

In more detail, this teaches how to tie, using video surveillance, a phone number X to a person Y tracked in an event, using many-to-one matching between people and phones, and filtering down until there is a one-to-one match.

I. BACKGROUND

POLICE/SECURITY know a lot about people using the pattern of their phone usage. They know who you are, who your friends are, if you are a risk etc. There is a lot of work on phone related security. Analysis of phones in the event can also tell us a lot. See some research in K. Dyagilev, S. Mannor, E. Yom-Tov (2013) "On Information Propagation in Mobile Call Networks" Social Network Analysis and Mining, Y. Richter, E. Yom-Tov, N. Slonim (2010) "Predicting customer churn in mobile networks through analysis of social groups" Proceedings of the 2010 SIAM International Conference on Data Mining (SDM 2010), Columbus, OH.

It will be nice if we could tie phones to specific people in an event. In some cases, if we have very good camera, can use face recognition, and if the person is using a registered phone this is enough. Mostly we will not be able to do that, the camera shots may not be good enough for face recognition when we don't have the time to do proper installations. In addition, the phone may not be registered to the person.

It is very useful for security to have attached to each person in the event (or to most people) his or her phone. On people the phone is registered to we gain a lot of information. We may know if he is a security risk, who are his friends, and a lot of other information. If the phone is not attached, we know that the person is walking with unrecognized SIM, we know who he talks to in the event and we may know who he is, using his patterns of talks.

This solution assumes that the entity providing the security can be in co-operation with the phone company, or can legally set interception on the phone identity using man in the middle such as in https://en.wikipedia.org/wiki/IMSI-catcher

II. SUMMARY OF THE INVENTION

The disclosure teaches how to tie, using video surveillance, a phone number X to a person Y. Person Y before the tying was one of the people tracked in the event (all people are tracked), and technology exist for continuing tracking people which is not the innovation in the disclosure.

We use multiple techniques to achieve this goal. We will not get full coverage but fairly good one
- Tracking people across the event. This is background CCTV technology is well known in the art; will not explain how it is done
- Tracking phones across the event. The accuracy is of about 15 meters
- Detecting people talking on the phones

This is a many to one matching between people and phones. If a person moves a lot, we will likely get a one to one matching. So if a phone was in location A with 100 people within 15 meters it belongs to one of them. 10 minutes later it is in location B with 100 people around them (but the intersection is 10) the phone belongs to one of these 10.
After a little while, we get one to one on people that do not stay in specific groups. Going to the toilet will assign a phone to a person even if normally in a group.

Accuracy will improve if we work in the approach to the event as well. It is likely that if three people go together we don't know to which of the three the phone belong. In this case we have a group of 3 phones and 3 people and have a clique. This is useful information. If the clique separates we will get the one to one.

With this analysis we will get small cliques and one to one.

We enhance the correlation by detecting of person talking on the phone (for example by putting it to his head). Correlating that with the line which is talking on that time will fasten the analyses. So if there are three people with three phones and we don't know which phone belong to which person but one of the them talks and one is busy, that person is likely the owner of that phone.

III. HOW IS THIS INVENTION MADE AND USED

To assign a phone number to a person we perform the

following

1. We track people using video. This is not the innovation of this solution but the result is that for people (whose identity is unknown), we have a partial map of location and time. Both location and time are very accurate.

2. We track phone number location in the cellular network. This means that we know for each phone number its approximate location all the time. The quality of the approximation may be as good as 15 meters on average. We do the tracking in the event and in the approach to the event.

3. We map phone numbers into people. In the beginning the map is one to many. For example, assume we have a phone number and in the location of the phone number there are 100 people. So the phone could belong to any one of them. Later the phone could be part of a group of 50, and then it belongs to the intersection of those 50 and the 100.

If a group of people arrive together and stay together the whole time, then their phones will not be distinguishable but we will still know that the three phones belong to those three people. If one of them separate for a moment, for example to go to the toilet, we will know which phone belong to him.

We can get even better data if check when people are talking on the group. The idea is that a phone belongs to someone in a group. That phone is active in a conversation, and only a subset of the people in that group are currently talking on the phone. The phone has a high probability of belonging to one of them. Video detection of talking can be seen in http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.35.386&rep=rep1&type=pdf.

IV. FINAL COMMENT

People can be of the following four categories

1. They use their own phone
2. They use an unregistered phone
3. They use someone else's phone (or stolen phone)
4. They don't use a phone

While we previously discussed the first two categories, not using a phone is also a simple category with the same technology. It just means that the intersection calculated is empty. People with no phones may also be suspicious.

People who use someone else's phone may be detected in two ways. The first is simple, we know the phone belong to Shmuel who is a 6'3" white person but it is used by a female, so not his. The second is using the call pattern. If the phone is used in a ways that is not typical, calling people never called before from that phone, being part of conversation never before happening, this is also suspicious.