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The Design of a Spatio-Temporal Database to investigate on sex offenders

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Abstract

Sex offenders have a high recidivism rate. Fight against recidivism is, therefore, a relevant issue. Recent laws call for the use of the GPS technology to monitor the whereabouts of sex offenders. In the paper, we design a Spatio-temporal database suitable to store the trip of criminals as moving points that is as time dependent geometries. This opens the frontier to a new generation of software applications much more effective than those currently used by several criminal investigation departments all over the world.

Keywords: sex offender; criminal mobility; moving points; database

1. Introduction

Sex related crimes are a serious social problem because they cause devastating consequences for victims, families, and communities, and because of the high recidivism rates. For instance, a research by the Ministry of Justice of Japan reveals that 30% of repeat offenders were responsible for 60% of the crime committed in Japan from 1948 to 2006, [1]. The prevention of recidivism needs effective strategies to supervise sex offenders. Many jurisdictions have implemented residency restrictions. As quoted in [2], unfortunately "Residency restrictions have had little measurable crime reducing impact. Another measure against sex offenders is the so-called "registration and notification policy" that exists in many countries around the world since a long time. Unfortunately, even this policy did not reduce crime rates tangibly [3].

More recent laws call for the use of the global positioning satellite (GPS) technology to monitor the whereabouts of habitual sex offenders. This is the answer to the widespread social expectations, as it can be read

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in [4] which ends by reporting that "Magistrates and health professionals complain the lack of effective monitoring procedures for released offenders." The adoption of GPS based monitoring policies, however, raises the critical issue of the violation of the personal privacy, a fundamental human right established in international laws and regulations. A debate about such concern is still on the carpet (e.g., [2]). The central point, of course, concerns *how* to treat the data about the movements of sex offenders.

This article adopts a Database Management System (DBMS) that supports data types and operators for the so-called moving points (in short, m-points) as meant in [5]. M-points are time dependent geometries. Two views on m-point data have been established in the past. The first one focuses on answering questions on the current position of m-points, and on their predicted temporal evolution in the (near) future. This approach is often called *tracking* [6]. A second approach represents (in a single database attribute) complete histories of m-points inside so-called *trajectory databases*, [5]. Of the two approaches, the second is better suited, in our opinion, to be used to study the movements of sex offenders mitigating, at the same time, the issue of privacy invasion even more pronounced in the case of tracking that implements a real-time control of people actions. Choice, the latter, that although decidedly "punitive" offers no certainty that it can produce beneficial effects on the reduction of the recidivism rates among sex offenders. At least, as mentioned, there are no studies that prove it.

The paper is structured as follows. Sec. 2 introduces the reference scenario about sex offenders and their movements. Sec .3 concerns the design of a spatio-temporal database collecting the data about the problem and its implementation in the SECONDO DBMS [7]. Sec. 4 presents an example dataset used to feed the database. Sec. 5 concludes the paper and sketches the future work.

2. The application context

As mentioned above, the reference scenario of the study summarized in this paper concerns sex offenders whose movements are tracked (hereinafter, therefore, also called *subjects on probation*), sensible areas (schools, parks, public restrooms, train stations, ...) and movements of subjects on probation between sensible areas. The position of the sex offenders is acquired by an electronic device equipped with a GPS detector. Such data are transmitted to a server and filed for a certain number of years (according to the national and international laws in force).

In the paper we use the following notations.

$\mathcal{C} = \{C_1, C_2, \ldots, C_c\}$: the known sexual crimes,
$\mathcal{P} = \{P_1, P_2, \ldots, P_p\}$: the pending sexual crimes,
$\mathcal{S} = \{S_1, S_2, \ldots, S_s\}$: the subjects on probation,
$\mathcal{A} = \{A_1, A_2, \ldots, A_a\}$: the sensible areas,
$\mathcal{T} = \{T_1, T_2, \ldots, T_t\}$: the movements.

In turn, Ti = {<P,t> | *P* is a point described by a pair of coordinates <lat, long> and *t* is the time stamp of the acquisition of *P*}, where i=1, 2, ..., |T|. The elements of T_i are temporally ordered. T_i expresses the trip of a subject in $\mathcal{S}$ between two sensible areas in $\mathcal{A}$.

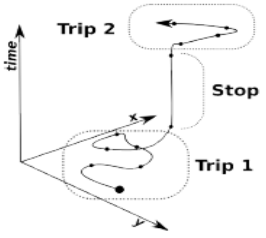

Figure 1. The whole GPS trace of a subject on probation made up of intermediary trips