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Review

Predicting residential burglaries based on building elements and offender behavior: Study of a row house area in Seoul, Korea

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ABSTRACT

Current methods for predicting residential burglaries mostly rely on analyses of crime patterns based on a real information. While this model is valid on an urban scale, it fails to consider street-scale environmental factors as well as offender behaviors in response to those factors. To improve the predictability of crime-simulation studies, this study investigated two influential factors in the occurrence of residential burglary: the physical properties of building elements and offender behaviors in response to those properties. First, a prediction algorithm was designed based on analyses of the factors. Next, a prediction method was established by modeling a virtual 3-D environment and a virtual offender using the algorithm. Lastly, the probability of residential burglary was analyzed via a simulation using the prediction method. A comparison of the simulation results with actual residential burglary data confirmed that the proposed method has statistically significant predictability.

Contents

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1. Introduction

Existing studies have invested a great deal of effort in developing methods for predicting residential burglaries by focusing on target-area environments. Chainey, Tompson, and Uhlig (2008) emphasized the physical environment as an influential factor in residential burglary rates. However, that study limited its focus to urban-scale factors, which do not sufficiently account for the influence of the physical properties of residences on burglary occurrence. Recently, an agent-based crime-simulation model was developed that integrates environmental factors (e.g., physical, social, and economic environments) and offender behavior to predict residential burglaries (Malleson, Heppenstall, & See, 2010; Malleson, Heppenstall, See, & Evans, 2013). The advantage of using an agent-based model (ABM) as an alternative to real offenders is that it gives researchers valuable insights into offender behavior for predicting residential burglaries. Despite such benefits, the crime simulations in those studies (Malleson et al., 2010; Malleson et al., 2013) had incomplete prediction results. This was mainly because the use of 2-D data based on geographical information systems (GISs) excluded 3-D data showing the physical properties of buildings.

To improve existing models, this study proposes a method for predicting residential burglaries on an individual-building scale by investigating two influential factors: the physical properties of building elements and offender behaviors in response to the environment. First, factors that influence the occurrence of residential burglary (i.e., the physical properties of building elements and offender behavior) are analyzed to design a prediction algorithm (Fig. 1a). Second, a virtual offender is developed based on the algorithm, and a virtual 3-D environment model is developed (Fig. 1b). Finally, based on these applications, the influence of physical building properties and offender behavior on residential burglary is analyzed (Fig. 1c).

2. Literature review

2.1. Environmental criminology and offender behavior theories

Studies of target-area environments mention various factors that affect residential burglary: the absence of a social community (Bottoms & Wiles, 1986), regional income gaps (Bernasco & Luykx, 2003), changes in visibility according to time (Ratcliffe, 2006), urban environmental elements (Cromwell & Olson, 2005), and residential building design elements (Armitage, Monchuk, & Rogerson, 2011). Based on these studies, environmental factors influencing residential burglary can be categorized into four types: physical environment factors, economic factors, social factors, and temporal factors.

Studies of offender behavior have employed routine activity theory and rational choice theory. Routine activity theory suggests that crimes occur when the following three conditions are present: a motivated offender, a suitable target, and the absence of a motivated guardian (Felson, 1987). Crimes occur as a result of the compatibility of visibility, accessibility, attractiveness, and guardianship. While this model can explain the situations in which crimes may occur, it does not adequately explain why people commit certain crimes (Shin, 2012; Akers, 2013).

Rational choice theory, which explains offender behavior, emphasizes the rational aspect of offender behavior. Offenders make rational decisions by comparing profit and risk in relation to crime (Clarke & Cornish, 1985). The purpose of residential burglary is to obtain property; therefore, burglars often act on the basis of rational decisions compared to other types of offenders (Eck & Weisburd, 1995).

A burglar's rational choice is decided based on the following crime-opportunity factors: risk factor, ease factor, and reward factor (Bennett & Wright, 1984).

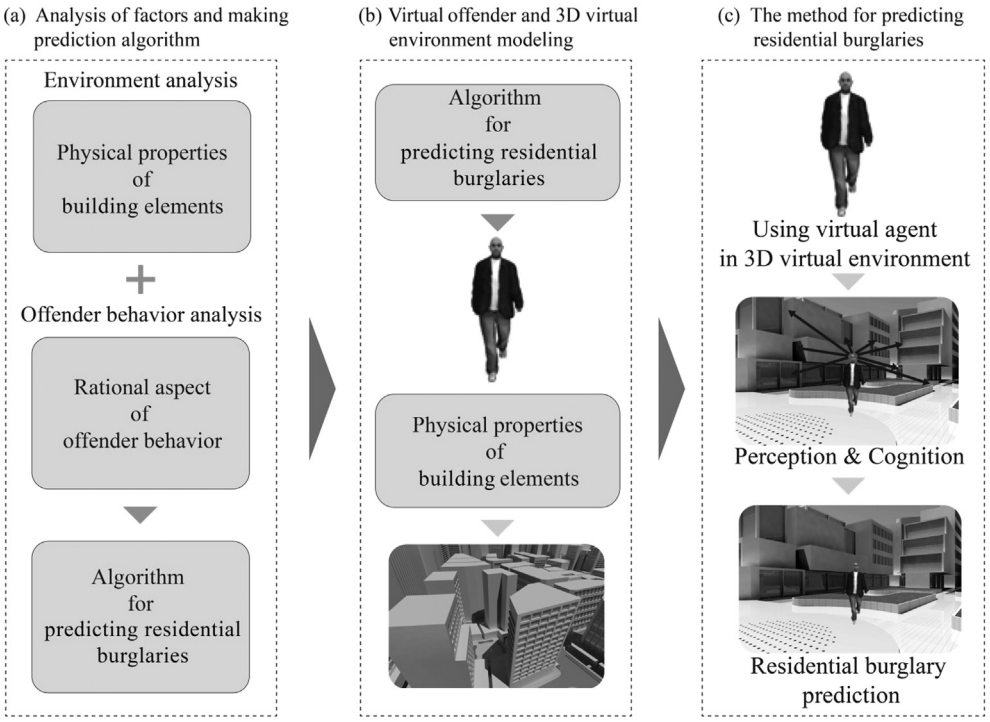

Fig. 1. Process for predicting residential burglaries.