Inferring Social and Internal Context Using a Mobile Phone

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Abstract

This dissertation is composed of research studies that contribute to three research areas including social context-aware computing, internal context-aware computing, and human behavioral data mining. In social context-aware computing, four studies are conducted. First, mobile phone user calling behavioral patterns are characterized in forms of randomness level where relationships among them are then identified. Next, a study is conducted to investigate the relationship between the calling behavior and organizational groups. Third, a method is presented to quantitatively define mobile social closeness and social groups, which are then used to identify social group sizes and scaling ratio. Last, based on the mobile social grouping framework, the significant role of social ties in communication patterns is revealed. In internal context-aware computing, two studies are conducted where the notions of internal context are intention and situation. For intentional context, the goal is to sense the intention of the user in placing calls. A model is thus presented for predicting future calls envisaged as a call predicted list (CPL), which makes use of call history to build a probabilistic model of calling behavior. As an incoming call predictor, CPL is a list of numbers/contacts that are the most likely to be the callers within the next hour(s), which is useful for scheduling and daily planning. As an outgoing call predictor, CPL is generated as a list of numbers/contacts that are the most likely to be dialed when the user attempts to make an outgoing call (e.g., by flipping open or unlocking the phone). This feature helps save time from having to search through a lengthy phone book. For situational context, a model is presented for sensing the user's situation (e.g., in a library, driving a car, etc.) based on embedded sensors. The sensed context is then used to switch the phone into a suitable alert mode accordingly (e.g., vibrate mode while in a library, handsfree mode while driving, etc.). Inferring (social and internal) context introduces a challenging research problem in human behavioral data mining. Context is determined by the current state of mind (internal), relationship (social), and surroundings (physical). Thus, the current state of context is important and can be derived from the recent behavior and pattern. In data mining research area, therefore, two frameworks are developed for detecting recent patterns, where one is a model-driven approach and the other is a data-driven approach.