Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

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ContextAiDe: Context-Based Resource Optimization for Real-Time Mobile Crowdsensing

Background

Mobile crowdsensing (MCS) enables development of context-aware applications by mining relevant information from a large set of devices selected in an ad hoc manner. For example, MCS has been used for real-time monitoring such as Vehicle ad hoc Networks (VANET)-based traffic updates as well as offline data mining and tagging for location-based services.

Current MCS design approaches seek to improve reliability of contextual information by increasing the number of volunteer devices such that a larger fraction of acquired data has relevancy. This results in the transfer of large amounts of data to the cloud or edge devices as well as high consumption of processing resources. The burden on a volunteer device is further exacerbated by the resource limitations and communication costs (both energy and bandwidth) in an ad hoc environment. Therefore, advancing real-time MCS operation in such constrained and unpredictable environments requires careful optimization of various components including volunteer device selection, sensing computation and communication distribution, and fault tolerance.

Invention Description

Researchers at Arizona State University have developed ContextAiDe, an MCS architecture that combines an API, middleware, and an optimization engine. The key innovation in ContextAiDe is its context-optimized user recruitment for computation- and communication-heavy MCS applications in an edge environment. This is achieved through the use of two types of contexts: Exact (hard constraints which must be satisfied) and Preferred (soft constraints which may be satisfied to a certain degree). By adjusting the preferred contexts, ContextAiDe optimizes peer-to-peer offloading of tasks to enable real-time operation. When tested against a competing strategy in a real-time perpetrator tracking application, ContextAiDe reduced energy consumption by 37.8%, data transfer by 24.8%, and time incurred by 43%.

Potential Applications

- Location-based, real-time monitoring
  - Contact tracing
  - Infrastructure and vehicle traffic
  - Health and environment
  - Perpetrator tracking

Benefits and Advantages

- Allows collaborative realtime applications using dynamically discovered devices
- Enhances performance with less time and less energy consumption
- Incorporates machine learning and statistical methods to predict context patterns

Related Publication

Laboratory Homepage of Professors Sandeep Gupta and Ayan Banerjee