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Liu, Ying and Xu, Zhijie

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A Big Data-inspired Spatio-temporal Story Model for Forensic Evidence Validation
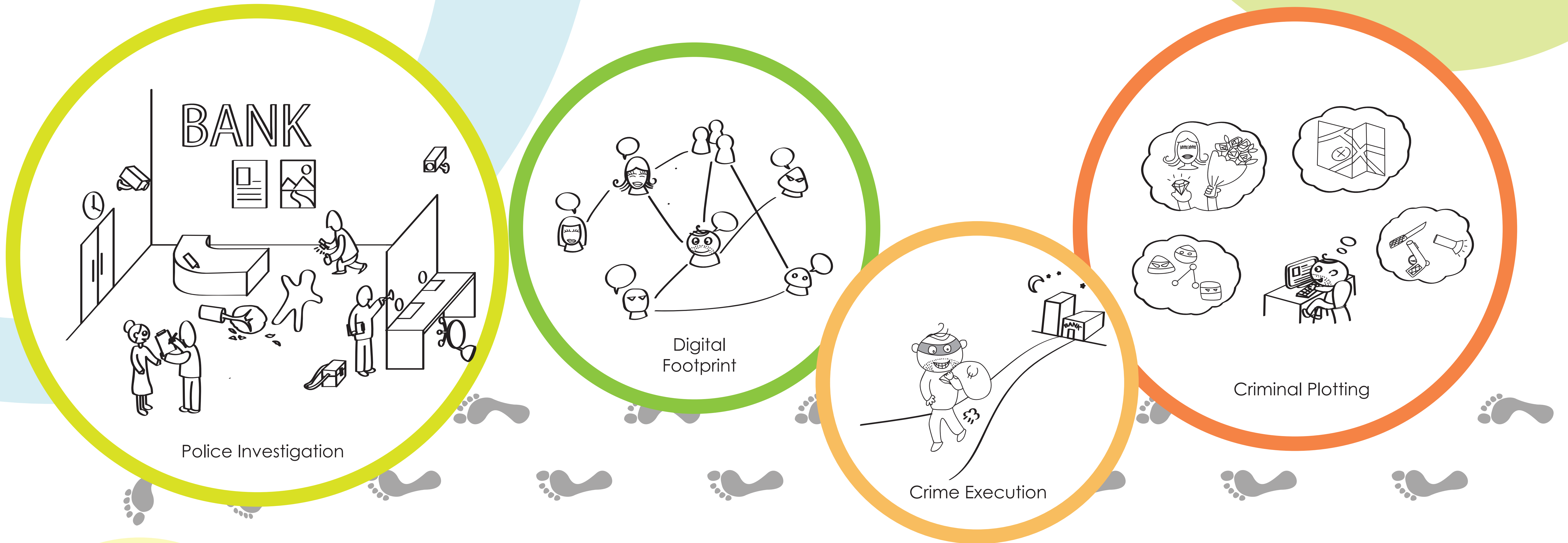
Ying Liu[1], Zhijie Xu[2]

[1]ShaanXi Forensic Science and Court Technology Centre, Xian University of Post and Telecommunications, 710121, Xi'an City, P. R. China
[2]Vision, Interaction, and Visualisation Research Group, University of Huddersfield, Queensgate, Huddersfield HD1 3DH, UK

Digital Forensic Evidences (DFEs) are more than digitised computer data chunks. They may contain complicated causality relationships within specific timelines and feature domains. Recent developments in forensic science study have shown that DFEs should be treated as part of the concept of "Big Data" formed by the explosively increasing electronic data generated by Internet, social networks, consumer electronics, and public surveillance systems.

BANK

Police Investigation

Digital Footprint

Crime Execution

Criminal Plotting

Evidence

Forensic Reoprt

DEFs Collections

STV Analysis

Big Data

Challenges

Psychological research has found that the accumulative style piece-by-piece DFE presentation often failed to generate linear aggregation of "knowledge" regarding a particular case, although the so-called "truth" kept stacking up. Human judgment processes can be classified into 3 types, constant updating or on-line style, reflective or memory-based, and hybrid inference-memory-driven; with the last type considered most objective and unbiased. However, all those approaches suffer from the so-called "curse of dimensionality".

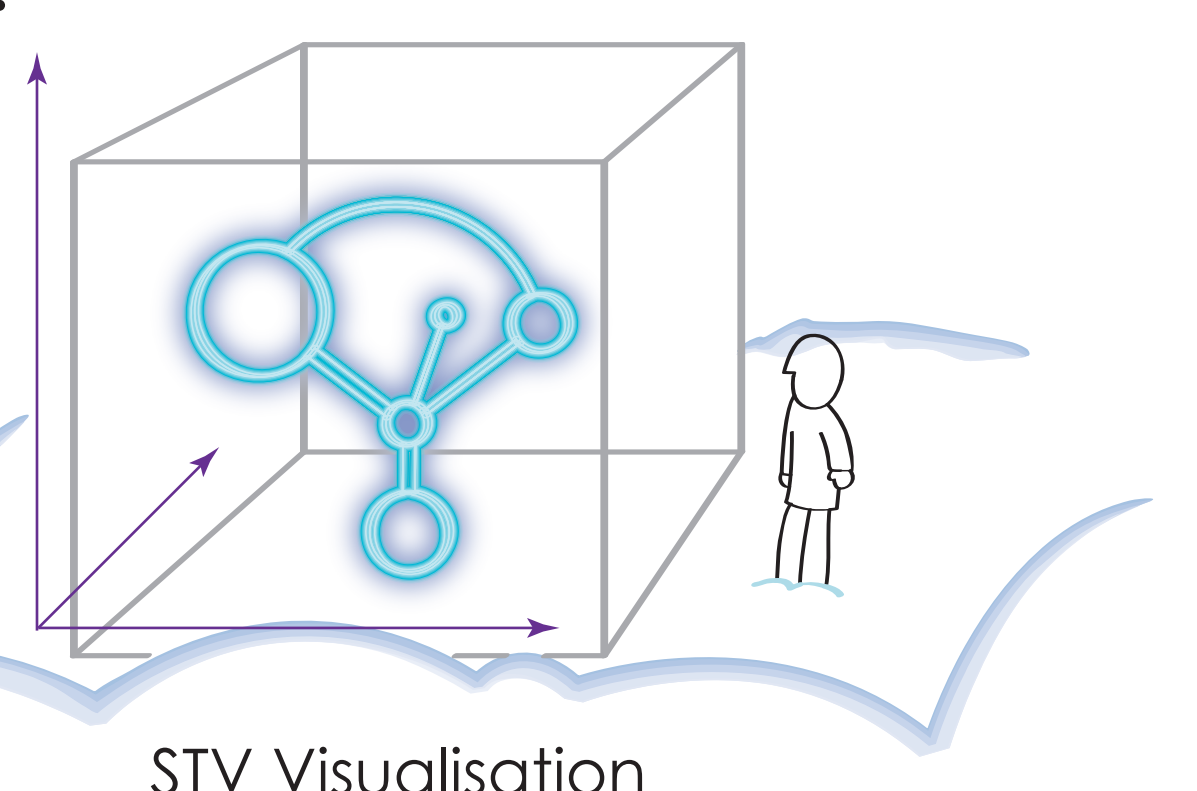When   Where   Why
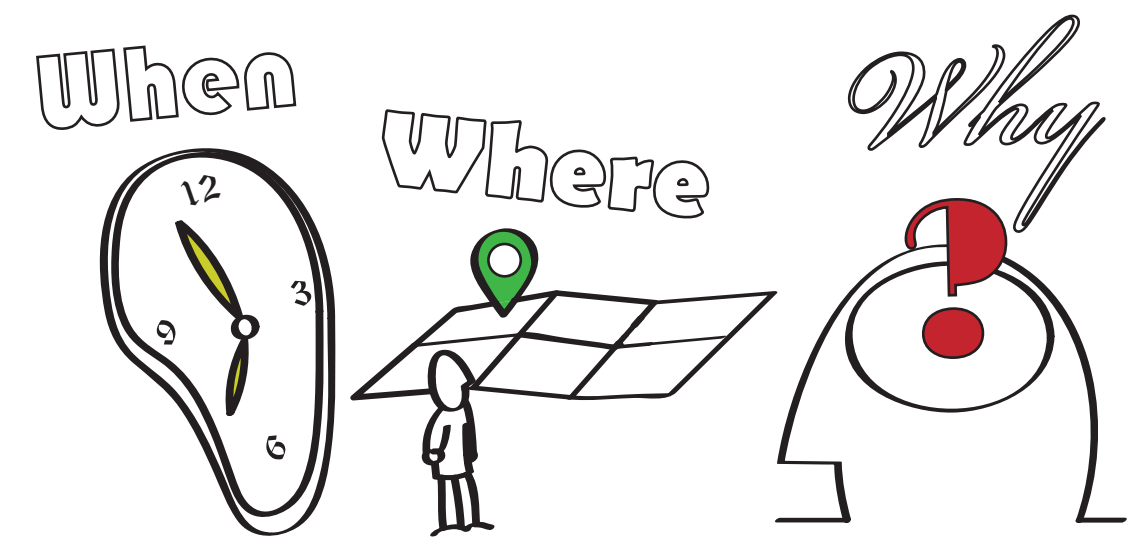
Proposed Solutions

This project aims at developing a unified DFE management platform - STV - driven by the Big Data concept. Within a STV model, not only the vital evidences can be stored and tested piece-by-piece, but the very way for establishing their causality can be visualised and examined. The VIV and SFS&CTC research groups have been working closely together in developing methodology and techniques for the STV Story-Model through highlighting DFEs' spatial feature distribution (for the evaluation of evidence validity, correlation, and interpretation) and establishing the temporal sequences of legal theories ("Stories") in a dynamic and interactive 3D environment.

The system is based on a spatio-temporal volume (STV) structure, which creates a global view over all available facts linked by hypothetic event timelines. A "story" reviews the entire DFE chains and assesses the complicated causality relationships across the "Big Data" network. The system will enable legal proceedings such as police investigation, jury deliberation, or court presentation being encapsulated and performed within an enclosed model, where DFEs are represented as "nodes" that can be edited, manipulated, and visualised in customisable manners.

Supporting Technologies and Core Theories

- Feature-based Machine Learning, Big Data and Web Crawling;
- Content-based Image Retrieval and Category Theory;
- Augmented Reality and Interactive Visualisation;
- Argumentation and Story Model Theories, etc.

The envisaged contribution from such a platform is that it enables not just the DFE nodes but their spatial-temporal "glue" or "anti-glue" being examined in a computerised and augmented 3D environment. The visual and interactive manner for carrying out such a truth-finding journey will see the story-model construction operations becoming a transparent and validated process.

STV Visualisation