ICONIC REPRESENTATION TECHNIQUES FOR ION DYNAMICS IN GLASS STRUCTURES

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ICONIC REPRESENTATION TECHNIQUES FOR ION DYNAMICS IN GLASS STRUCTURES

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A thesis submitted in fulfilment of the requirements for the award of the degree of Doctor of Philosophy (Computer Science)

Faculty of Computer Science and Information System
Universiti Teknologi Malaysia

JUNE 2012
I declare that this thesis entitled "Iconic Representation Techniques for Ion Dynamics in Glass Structures" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Dedication . . .

My Father, Hj Mohamad Sharif Bin Mohd Yusoh
My Lovely Mother, Hjh Halimatun Binti Hj Awang
    My Wife, Rohani Binti Hamdan
    My Daughter, Aisyah Binti Johan,
        Khadijah Binti Johan,
        Siti Hajar Binti Johan
    My Son, Adam Bin Johan,
        Idris Arshad Bin Johan
    My Father in-Law, Hamdan Bin Hj Junit
    My Mother in-Law, Manisah Binti Ibrahim
    All friend and colleagues
    Precious friends and sisters

Thank you for your immense love, your precious pray, supports and anything that you have done to me.

May the blessings of Allah shower upon you.
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ABSTRACT

Ionic conductivity in a glass structure generates electrical flows, or ion trajectories, which produce electricity. Ion trajectories with an appropriate representation technique help in understanding properties of the ionic conductivity. Most of the existing techniques employ two-dimensional graphs to represent the properties. However, some of the important properties particularly spatial structures, timelines and collaborative events could not be clearly represented. Thus, this study aims to address these drawbacks by proposing a new technique using iconic representation in three-dimensional space. The proposed technique begins by transforming a set of vectors into two iconic geometrical shapes, namely cylinder and cone in order to visualise the spatial structure such as orientation, direction and magnitude. Later, a navigation function has been used to manoeuvre a viewpoint with regards to the geometrical shapes. Next, a halo function has been employed to improve the representation of the cone by illuminating its trajectories. Subsequently, three transparency schemes have been proposed for zooming purposes to visualise the cones inside the cylinder. In addition, the trajectory of geometrical shapes has used to represent two time scales for timeline namely, the global colour time scale and the local colour time scale. The former represents a global time scale for trajectory of the cylinders, while the latter represents a local time scale for trajectory of the cones. The time scales allow the determination of time of occurrences for collaborative events such as orientation, velocity and gap. Finally, highlighted and de-highlighted functions are used to represent these collaborative events. A series of experiments have been conducted using a simulated data set to evaluate the performance of the developed technique. The experimental results have revealed that the spatial structures, timelines and collaborative events of the trajectories are precisely represented in the three-dimensional space.
ABSTRAK