Suggested Research Directions for a
New Frontier – Active Conceptual Modeling

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Abstract. This paper discusses several research directions and challenges of a new frontier of research: active conceptual modeling. It suggests how the Entity-Relationship (ER) model may be extended to satisfy some of the needs of a new set of emerging user needs and applications.

Keywords: Conceptual Modeling, active conceptual modeling, the Entity-Relationship model.

Introduction

Conventional/traditional conceptual modeling concentrates on modeling the static views (i.e., the snapshots) of the world. Even though the static conceptual models have been used successfully in the past and will continue to do well in the near future, there is a need for make the conceptual model "active" to handle a new set of user needs and applications.

The Needs for Active Conceptual Modeling

The growing needs of traceability for the evolving and changing world state. There are also increasing needs for understanding relationships among changes, and they have significance to current world state (e.g. terrorist training could have changed since the 9-11 attack). In other words, one of the major needs today is an "advanced conceptual model" which may be useful in analyzing surprises, crises, unconventional events (such as unconventional attacks). Some notable recent major incidents and events that forced us to look back the past events and changes in the world to look for clues and reasons include the following:

- The September-11 Attack of the World Trade Centers and Pentagon
- The tsunami disaster in Southeast Asia and East Africa
- The hurricane Katrina disaster.

There is a need to develop an "active conceptual Model," which will allow for continuous learning and provide traceable lessons learned from past experiences,

surprises. The active conceptual model may also be potentially useful for
future actions.

lems of Existing Methodologies/Technologies

ng methodologies (including the static conceptual models) and technologies
proven to be very useful in the past and will continue to be so for certain
ns in the foreseeable future. However, they may need to be modified in
andle fast time-varying and time-dependent changes in world states. In
there are several areas that the existing technologies and methodologies
modified or extended:

Current databases/knowledge-bases usually do not support information and
chema changes or historical information because they usually only model
e snapshots of the part of the world of interest

Current state-of-art techniques focus on pre-defined entities of interest and
heir static relationships

Virtually no constructs in the exiting conceptual models are available for
modeling changes of the entity behaviors (e.g. terrorist profiles) and the
ynamic and time-varying relationships among them

Using the constructs of the existing conceptual models, it is very difficult to
model a wide spectrum of situations resulting from different degrees of
mportance of the relationships due to different perspectives

The Schemas of the current data models are difficult to be changed
ynamically.

rting Point for Active Conceptual Modeling

e decades of efforts of many researchers and practitioners, the conventional
onceptual modeling methodologies and techniques based on the Entity-
hip (ER) model and its extensions [1-8] have being practiced daily by
of thousands of professionals and developers all over the world. Now, the
ght to start a major research and development effort in active conceptual
However, there are many challenging research problems which need good
such as:

ime/Space: How can we model the "time" and "space"?
cenario: How can we describe a scenario?
layers: Who were involved and what roles did they play?
ause/Effect: What is the best way to describe the cause-effect relationship?
vent/Activity: Do we need different symbols (icons) to represent event and
ctivity? How can we relate events with activities?

the User/Operation Perspectives, the static ER Model needs to be extended
following directions:

Represent the difference between snapshots by a "delta" model
dentify relationships in the "delta" model and additional attributes
Create a database for learning purposes
Users can query this database to study the status of the world state with
espect to the changes and their relationships

of these issues have been studied in the past, but we need coherent and
solutions!

conceptual modeling is a continual process of describing all aspects of the
d, its activities, and its changes under different perspectives, based on our
e and understanding. For any given time, the model can be viewed as a
and multi-perspective high-level abstraction of reality. How to develop
ual model that can have these kinds of features and capabilities (and in a
and coherent way) is a great challenge!

lusion

ceptual models have been used successfully for at least the past 3 decades.
of new and emerging user needs and applications, we need an "active
l model."   We have discussed the weaknesses of the existing static
l models, methodologies, and technologies in handling some of the new and
applications and suggested several directions to extend the Entity-
hip (ER) model to make it an "active conceptual model." We have raised
icult research issues and questions that need clean solutions so that the
ceptual modeling can be moved from the research stage to the development
then to the practice stage. We hope the R&D community will be able to
d perfect the active conceptual modeling methodologies and techniques
o that we can realize the benefits [9] of the active conceptual modeling in the
stant future.

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