Demo Abstract

Collaborative Editing and Selective Undo

Undo is a key feature of editors. In a single-user editor, a user can conveniently undo earlier editing operations in reverse chronological order. In a collaborative editor, however, users at different sites may generate operations concurrently. This means that a user cannot easily perceive a meaningful linear sequence of operations. In the research community of collaborative editing, selective undo is widely regarded as an important feature [4, 7, 9, 11–15]. With selective undo, a user can undo an earlier operation, regardless of when and where the operation was generated.

However, despite wide acceptance in the research community, selective undo is practically not supported.

A selective-undo system should support the following features:

- **Operation granularity.** Text editing is character-string based in nature. Operations on existing text may have arbitrary granularity. Undo or redo character by character would be very inconvenient. Furthermore, some operations may consist of a number of sub-operations. Examples include indentation of source-code blocks, multiple text substitutions, etc.
- **Operation dependencies.** Undoing an arbitrary earlier operation may lead to undesirable effects due to operation dependencies. For example, a user first inserts a misspelled word and then makes a correction. The correction depends on the insertion of the word. It is undesirable to undo the insertion of the word alone and leave the correction part behind.
- **Operation selection.** The user should be able to conveniently view, find and select earlier operations in order to perform the undo.
- **Convenience.** Most of the time, the user should be able to effortlessly undo a default operation. This should not be less convenient as in a single-user editor.

In this demo, we present all the above-mentioned features as part of a collaborative editing system implemented in the widely used GNU Emacs text editor. To the best of our knowledge, this is the first and only collaborative editor with such comprehensive selective undo features.

State of the Art

There are two general approaches to collaborative editing, based either on operation transformation (OT) [3, 12, 13] or on commutative replication data types (CRDT) [2, 6, 8, 10, 14, 15]. With OT, a remote operation is transformed and integrated in the local site. The time complexity depends on the lengths of operation histories (linear at best). Furthermore, it is hard to design correct operation transformation functions [5]. One common way to relax certain required conditions for transformation functions is to restrict the order in which operations are transformed at all sites. Consequently, OT approaches generally do not scale well and practically require the
involvement of central servers. With CRDT, concurrent insertions are ordered based on the underlying data structure, so the time complexity may not depend on the lengths of operation histories. It is reported [1] that CRDT algorithms are better suited for large-scale distributed environments and outperform OT algorithms by orders of magnitudes.

Supporting string operations and selective undo requires obtaining at runtime relations among operations, such as whether a string is part of a deletion or whether an operation is an undo of another operation. Since strings might be split by subsequent operations and operations are executed concurrently, obtaining such relations can be complicated. Deriving such relations through operation transformation is particularly difficult. Currently, most related work could only perform undo on insertion and deletion of fixed objects (characters or unbreakable lines) [4, 7, 9, 11–14]. Only our previous work [15, 16] supports selective undo of operations with dynamic and appropriate granularity. Our work [16] is the first that accounts for possible undesirable effects of undo due operation dependencies.

The work presented in this demo is built on [16].

Selective Undo Features
The demo shows the following selective undo/redo features that we have implemented in GNU Emacs 24.5.
• undo or redo of any previous insertion or deletion, even when these operations are split by subsequent operations;
• undo or redo of any previous group operations like multiple substitutions and block indentation,
• display of editing history;
• different ways of filtering the displayed history, such as with selected regions in the document, regular expression matches, etc.;
• navigation through operation history;
• effortless undo and redo, in particular, if no special effort is made, undo and redo would be the same as in a traditional single-user editor.

Figure 1 shows a document under editing, with a history view to the right and a filter-select-undo sub-menu at the bottom.

![Figure 1. Document editing with selective undo features](image)

Conclusion
Selective undo has long been regarded as a desirable feature of collaborative editors. However, support for selective undo has remained for over two decades as a “research feature”. In this demo, we present an implementation of selective undo features and show that selective undo can indeed be practically usable.
References


Requirements and Target Audience

There is no special prerequisite. Anyone interested in computer-supported collaboration in general and co-editing a document with others in particular, users and researchers alike, should be interested in the demo. Researchers in collaborative editing and advanced Emacs users might be interested in technical details.

Demo Duration

The demo will be presented in a 30-minute session.

A/V and Equipment

The demo needs a projector with a laptop.
Presenter’s Biography

*Weiwei Yu* is an associate professor at the Department of Computer Science, UIT - The Arctic University of Norway. He received his PhD and Master degrees from KU Leuven, Belgium, in 1993 and 1989, and his Bachelor degree from Shanghai Jiaotong University, China, in 1985. His research interests include distributed systems, collaborative editing and services computing.
Demo Session II

AnalyticalInk: Examining Interaction Modality Effects toward Engagement in an Interactive Math Learning Environment

Bo Kang, Arup Kumar Ghosh
Department of Computer Science
University of Central Florida, Orlando, Florida, USA
Emails: bjang@cs.ucf.edu; arupkumar.ghosh@ucf.edu

Demo Abstract

AnalyticalInk is a sketch-based interactive math learning environment that students can use to solve analytical geometry math problems. The system helps students connect algebra and geometry conceptual knowledge using dual representations (e.g., written algebraic equations and Cartesian coordinate systems). It also improves student engagement and learning outcomes by combining two interactive features (e.g., self-constructed graphing and system-generated graphing) that encourage students to work with the system in order to co-construct knowledge. The collaborative nature of this system is, therefore, in students’ ability to work with AnalyticalInk to graph and/or manipulate system-generated visual representations of the algebraic equations, which helps them both hone their conceptual understanding of the problem and, more procedurally, successfully solve for the correct solution.

![Figure 2: AnalyticalInk Interface](image)

**Keywords**
E-learning, Education

**Requirements and Target Audience**

The demo is open to anyone who would like to solve 1 or 2 math problems using a Microsoft Surface with the stylus.

**Demo Duration**

The demo will be presented in a 30-minute session.
A/V and Equipment

We will provide a surface pro 3 tablet. A power outlet will be required depending the duration of the demo.

Presenters’ Biographies

Bo Kang is a Computer Science PhD student at the University of Central Florida. His research interests include learning technology and interaction techniques. He developed AnalyticalInk as part of his dissertation work.

Arup Kumar Ghosh is a Computer Science PhD candidate at the University of Central Florida. His primary research interests include Human-Computer Interaction (HCI), Mobile Computing, and Social Media. He is a co-collaborator on the AnalyticalInk project and will be presenting the demonstration.
Demo Session III

TeachLivE: Honing Your Teaching Skills in a Virtual Classroom

Charles E. Hughes
Synthetic Reality Laboratory, Department of Computer Science
University of Central Florida, FL, USA
Emails: ceh@cs.ucf.edu; cehcsucf@gmail.com

Demo Abstract

TeachLivE (http://teachlive.org/about/about-teachlive/) is a virtual environment where teachers can remotely interact with virtual students without doing harm to real ones. The environment has been used to help over 50,000 teachers improve their classroom skills without harming any children in the process of becoming better teachers. Come teach and learn from our virtual children!!

Requirements and Target Audience

This is open to anyone who would like to try his or her hand at interacting with a virtual classroom as the virtual student’s teacher.

Demo Duration

The demo will be presented in a 30-minute session.

A/V and Equipment

Large screen TV with HDMI input and integrated speakers. Computer, webcam and microphone will be provided.
Presenters Biography

Charles E. Hughes is Pegasus Professor of Computer Science in UCF’s College of Engineering and Computer Science. He is also Professor of Digital Media, Affiliated Faculty member in Text & Technology, Modeling & Simulation Graduate Program faculty member, and co-director of the university's Synthetic Reality Laboratory. He has held prior faculty positions at Penn State and the University of Tennessee. His research interests are in virtual environments, focusing on user interaction paradigms, participant emotional and performance analysis, and the application of VR experiences to interpersonal skills, teacher preparation, de-escalation skills, and protective strategies for self and others. He has been PI or co-PI on over $20M in grants, is author or co-author of over 200 refereed research publications, and is a co-inventor of the TeachLivE paradigm and technology. He holds a Ph.D. and M.S. in Computer Science from Penn State University and a B.A. in Mathematics from Northeastern University.
Demo Session IV

Psychological Wellbeing AI-Coach That Monitors and Supports Engagement of Humans Performing Skilled Creative Activities

Koray Tahiroğlu
Department of Media,
Aalto University, School of ARTS
FINLAND
koray.tahiroglu@aalto.fi

Demo Abstract

This psychological wellbeing goes well beyond the absence-of-illness definition of wellbeing, and it has particular relevance for the individuals and the preservation of what may well constitute the building blocks of their happiness. In the work that we present here, we focus on exposing the centrality of the individual’s engaging experiences in psychological-wellbeing enhancing activities. We seek to amplify the experience by mediating between the person and the activity in two complementary ways: (i) by monitoring the level of engagement of the person during the activity, and (ii) by having the object of the activity itself respond in subtle but meaningful ways to the process that is led by the person, in order to maintain consistently high levels of engagement. Taking musical creation as one such skilled activity, in this AI-Coach demo we plan to demonstrate an interaction method to monitor varying levels of engagement of a performer improvising on a hand-held music interface, in collaboration with a network of intelligent sonic agents.

The sonic agents receive system-controlled output parameters and the performer's control input, uses both control parameters to process their audio synthesis modules. Each agent is an individual musical instrument and has its own sound synthesis features. Three sonic agents all together represents a diverse sonic perspective of digital music instrument with their tonal, rhythmic and abstract audio characteristics. The instruments are extended to incorporate the collaborative music performance, as they become part of the distribution of decision-making, transforming their physical control inputs consistently and communicating with the performer within own acoustic contexts. The performance is the collaborative product of the interaction between performer and the AI-coach. These three-networked agents maintain their physical actions within a shared intelligent model, monitoring performer's bodily movements, facial expressions and control inputs. In this way, AI-Coach observes the performer and estimates his/her changing level of engagement during the performance, while learning the musical discourse. When engagement levels drop, the musical instrument makes subtle interventions, coherent with the creative discourse, until the performer's engagement levels recover. In a user study, we observed and measured the behaviour of our system as it deals with losses of performer focus provoked by the controlled introduction of external distractors. We also observed that being engaged in a creative activity contributed positively to participants’ psychological wellbeing. Motivated by the results obtained in the present study, we would like to explore further design and implementation of collaborative interfaces for AI-Coach to investigate similar engagement monitoring and maintaining techniques in a broader scope of skilled, potentially-mentally-absorbing activities between AI-Coach and multiple people.

Requirements and Target Audience

Table with size approximately 80cm (width) x 150cm (length) and 60 cm (height)

Demo Duration

The demo will be presented in a 30-minute session.
A/V and Equipment

Technical Requirements - to be provided by the conference organizers: Projector, power extension, a computer monitor with HDMI or DVI input (the system runs in mac-mini computer, I need a monitor to set-up the system for the demo session).

Presenter’s Biography

*Koray Tahiroğlu* is a musician, research fellow and lectures at the Department of Media in Aalto University School of ARTS. He has extensive experience as research group leader in sonic interaction, specifically in the sound and music computing research field. In particular, his research focuses on the emerging role of sound in designing new ways of interactions between humans and digital environments. It includes the design and implementation of novel inter-faces for digital media, communication, audio-visual production, music and interactive art with a very strong focus on embodied engagement in interaction. The research builds on ideas from real-world physical interactions in digital environments, audio-tactile augmentation, embodied interaction, smart technologies and new interfaces for musical expression. He has also a solid experience in international projects, in industry collaboration, in teaching and in supervising doctoral students.