computing devices edit a document concurrently in accordance with the principles of the present disclosure; and

[0023] FIGS. **27-31** illustrate changes to an exemplary user interface of a first authoring application as a first user and a second user collaboratively author a document in accordance with the principles of the present disclosure.

DETAILED DESCRIPTION

[0024] In the following detailed description, references are made to the accompanying drawings that form a part hereof, and in which are shown by way of illustrations specific embodiments or examples. While the disclosure will be described in the general context of program modules that execute in conjunction with an application program that runs on an operating system on a computer system, those skilled in the art will recognize that the disclosure also may be implemented in combination with other program modules. The embodiments described herein may be combined and other embodiments may be utilized without departing from the spirit or scope of the present disclosure. The following detailed description is therefore not to be taken in a limiting sense, and the scope of the invention is defined by the appended claims and their equivalents.

[0025] Embodiments of the present disclosure provide an environment in which multiple users can collaboratively author a document. FIG. **1** illustrates an example authoring system **100** having features that are examples of inventive aspects of the disclosure. The authoring system **100** includes a storage device **120** storing a master copy of a document **150**. In one embodiment, the storage device **120** can include a computing device. In another embodiment, the storage device **120** can include one or more storage devices (e.g., a network of computing devices).

[0026] The authoring system **100** also includes at least one user computing device **110** that is communicatively coupled to the storage device **120**. Each of the user computing devices **110** can edit the document **150** by creating a user copy **155** of the document **150** and editing the user copy **155**. The user copies **155** of the document **150** are synchronized when the user computing devices **110** periodically send to the storage device **120** updates to be shared with the other user computing devices and periodically obtain from the storage device **120** updates from other user computing devices.

[0027] As the term is used herein, a user computing device **110** includes any computing device that obtains a user copy of a document to be authored from a master copy of the document. The user computing device **110** can be different from the storage device **120** or can include a different user account implemented on the storage device **120**. In one embodiment, a computing device that acts as a storage device **120** for one document may act as a user computing device **110** for a different document and vice versa.

[0028] In the example shown, four user computing devices **110**A, **110**B, **110**C, and **110**D are communicatively coupled to the storage device **120**. In other embodiments, however, any number of computing devices **110** may be coupled to the storage device **120**. In the example shown, each user computing device **110**A, **110**B, **110**C, **110**D can send to the storage device **120** updates generated by the user of the user computing device and can request from the storage device **120** updates generated by the users of the other user computing devices. In one embodiment, the storage device **120** can be a server computing device and the user computing devices **110**A, **110**B, **110**C, **110**D can be client computing devices.

[0029] As shown in FIG. **2**, the document **150** stored on the storage device **120** can include content **152** and metadata **154**. Authoring applications **130** on the user computing devices **110** process and manipulate the content and metadata of the user copies **155** of the document **150**. In some embodiments, metadata **154** can be stored separately from content **152**. For example, content **152** can be stored in the document **150** and metadata **154** can be stored in a table (see FIG. **7**) separate from the document **150**. In other embodiments, however, the metadata **154** can be stored within the document **150**.

[0030] In general, the user computing devices **110** can synchronize updates to the content **152** separately from updates to the metadata **154**. In general, metadata updates **154** are automatically synchronized among the storage device **120** and user computing devices **110**, whereas content updates **152** from each user computing device **110** are synchronized at the request of the respective user.

[0031] FIG. **3** is a flowchart illustrating an exemplary synchronization process **300** by which an authoring system **100** can synchronize a copy **155** of a document stored on a user computing device **110** with the master copy **150** of the document stored on the storage device **120**. The synchronization process **300** initializes and begins at a start module **302** and proceeds to a first update operation **304**.

[0032] The first update operation **304** synchronizes the metadata of the copy **155** with the metadata of the document **150** without requiring any interaction with the user. For example, the first update operation **304** can provide an exchange of metadata between the storage device **120** and the user computing device **110** at periodic time intervals. In one embodiment, the first update operation **304** provides for an exchange of metadata every few seconds. In other embodiments, however, the first update operation **304** can provide for the exchange of metadata to occur in shorter or longer time intervals.

[0033] A request module **306** determines whether a request to synchronize content has been received. For example, the request module **306** can determine whether a user of one of the user computing devices **110** has requested to share content changes with other users. In another embodiment, the request module **306** can determine whether a user of one of the user computing devices **110** has requested to view content changes made by other users.

[0034] If the request module **306** determines that no request to synchronize content has been made, then the synchronization process **300** cycles back to the first update operation **304** and begins again. If the request module **306**, however, determines that a request to synchronize content has been received, then the synchronization process **300** proceeds to a second update operation **308**, which provides an exchange of content between the storage device **120** and the user computing device **110**. The synchronization process **300** completes and ends at a stop module **310**.

[0035] As the term is used herein, content updates **152** refer to any addition, deletion, and/or revision made to the substantive content of a document. For example, content updates for a word processing document can include added paragraphs (i.e., or sections thereof), deleted paragraphs (i.e., or section thereof), and/or revised paragraphs (i.e., or sections thereof). In another embodiment, content updates for a presentation document can include added, deleted, and/or revised pictures, text, animations, sounds, and other such data objects.

[0036] As the term is used herein, metadata updates **154** refer to any addition, deletion, and/or revision made to meta-