

data model objects and has a powerful data engine that retrieves the data according to the definition of the data objects.

Therefore, the present invention provides a novel report generation tool for developing, displaying and printing reports using a non-procedural, declarative approach that fully shifts the emphasis in report definition from program development to report design for both layout and data aspects. It also facilitates maintenance of existing reports. The declarative approach of the present invention provides an environment where a report definition is assembled by building objects and giving attributes to these objects. It significantly reduces the amount of programming required to define a report and greatly enhances the ease with which the report is defined.

Computer System

The present invention can be implemented on a general purpose computer such as illustrated in FIG. 7. A keyboard 710 and mouse 711 are coupled to a bi-directional system bus 718. The keyboard and mouse are for introducing user input to the computer system and communicating that user input to CPU 713. The computer system of FIG. 7 also includes a video memory 714, main memory 715 and mass storage 712, all coupled to bi-directional system bus 718 along with keyboard 710, mouse 711 and CPU 713. The mass storage 712 may include both fixed and removable media, such as magnetic, optical or magnetic optical storage systems or any other available mass storage technology. Bus 718 may contain, for example, 32 address lines for addressing video memory 714 or main memory 715. The system bus 718 also includes, for example, a 32-bit DATA bus for transferring DATA between and among the components, such as CPU 713, main memory 715, video memory 714 and mass storage 712. Alternatively, multiplex DATA/address lines may be used instead of separate DATA and address lines.

In the preferred embodiment of this invention, the CPU 713 is a 32-bit microprocessor manufactured by Motorola, such as the 680X0 processor or a microprocessor manufactured by Intel, such as the 80X 86, or Pentium processor. However, any other suitable microprocessor or microcomputer may be utilized. Main memory 715 is comprised of dynamic random access memory (DRAM). Video memory 714 is a dual-ported video random access memory. One port of the video memory 714 is coupled to video amplifier 716. The video amplifier 716 is used to drive the cathode ray tube (CRT) raster monitor 717. Video amplifier 716 is well known in the art and may be implemented by any suitable means. This circuitry converts pixel DATA stored in video memory 714 to a raster signal suitable for use by monitor 717. Monitor 717 is a type of monitor suitable for displaying graphic images.

The computer system described above is for purposes of example only. The present invention may be implemented in any type of computer system or programming or processing environment.

Thus, a method and apparatus for declarative report definition and generation using an enhanced, graphical data model and a graphical user interface for graphically specifying data items and data computations to be performed on the data are provided.

We claim:

1. A computer implemented method of defining a data report comprising the steps of:

defining, using a definition manager having a graphical user interface (GUI), a data model of said data report consisting of data model objects, said data model

graphically representing data items included in said data report and parameters corresponding to said data items;

defining, using said definition manager, a layout model of said report consisting of layout model objects, said layout model graphically representing physical format parameters of said report;

storing, using said definition manager, said data model and said layout model,

building, via a flow compiler, a data structure from said data model and said layout model, said data structure comprising an object and definition tree having nodes; using a formatter to format at least one page for said nodes of said tree; and

providing said page to an output device.

2. The method of claim 1 further including the steps of: determining, using a group manager, when a new instance of a node representing a repeating frame is to be formatted; and

setting appropriate data pointers on said new instance of said corresponding group exists.

3. The method of claim 2 further including the steps of: maintaining, using said group manager, data pointers used by said formatter;

obtaining, using said group manager, data described in said data model.

4. The method of claim 3 further including the steps of: providing data from said group manager to a calculation manager;

performing, using said calculation manager, calculations defined in said report definition on data provided by said group manager.

5. A computer implemented method of defining a data report comprising the steps of:

defining, using a definition manager having a graphical user interface (GUI), a data model of said data report consisting of data model objects, said data model graphically representing data items included in said data report and parameters corresponding to said data items;

defining using said definition manager a layout model of said report consisting of layout model objects, said layout model graphically representing physical format parameters of said report;

storing using said definition manager, said data model and said layout model,

wherein said data model objects are: Column, Cross Product, Group, Link, Parameter, and Query.

6. A computer implemented method of defining a data report comprising the steps of:

defining, using a definition manager having a graphical user interface (GUI), a data model of said data report consisting of data model objects, said data model graphically representing data items included in said data report and parameters corresponding to said data items;

defining, using said definition manager, a layout model of said report consisting of layout model objects, said layout model graphically representing physical format parameters of said report; storing, using said definition manager, said data model and said layout model,

wherein said layout objects are: Anchor, Boilerplate Arc, Ellipse, Freehand, Line, Polygon, Polyline, Rectangle, Rounded Rectangle, and Text Boilerplate objects),