a file by other classifications such as title, date, and reference number. If a user wants to retrieve a file by a particular string of text used in the file, he must specify the search argument after he activates the string-oriented index filing cabinet in Figure 6(a).

In addition to the retrieval capability, the file management facility allows a user to store a document into several different filing cabinets corresponding to the set of previously created indexes. An instance or all instances of an ib object can be filed at one time. To file an instance of an ib object, the user activates the associated ib icon, locates the desired instance, and presses the function key "file management". The file manager will respond by displaying several filing cabinets on the screen. The user may then file the document according to the existing classifications and/or specify other classification(s) by which the document is to be filed. If an ib object has only one instance or all its instances are to be filed as one entity, the user depresses the "file management" button after the cursor is positioned onto the associated ib icon.

8.2 Meeting scheduler
Scheduling meetings involves finding a meeting time convenient for all participants as well as determining the availability of a meeting place. In the proposed user interface, meetings are arranged by the meeting scheduler, one of the functions provided by the time management facility.

Upon pressing the key marked "time management", a list of functions plus three monthly calendars are shown on the display screen as exhibited in Figure 7. The three calendars on the left side of the screen show the past, current, and next month, respectively.

Scheduling meetings involves the use of an electronic appointment book, which is used to record the daily appointments schedule of an office employee (see Figure 8). The notion of an electronic appointment book is drawn from the PCAL (Personal CAlendar) system described in [11]. New events can be inserted, and scheduled occasions may be deleted or updated on the electronic appointment book. An office worker normally works eight hours per day, and these eight hours are divided into sixteen half-hour slots on the electronic appointment book.

To schedule a meeting, a user selects the appropriate choice in Figure 7 after invoking the time management facility. The system then displays an electronic image of a "Meeting Specification Form", which is shown in Figure 9. The user may specify only the duration of the meeting and its participants. The other items on the form will assume their default values if they are not specified.

**Figures:**
- Figure 7: The time management facility.
- Figure 8: A page of an electronic appointment book.
- Figure 9: A meeting specification form.

**Table:**

<table>
<thead>
<tr>
<th>APPOINTMENT BOOK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>22 Jun 02:02</strong></td>
</tr>
<tr>
<td><strong>Friday September 30, 1983</strong></td>
</tr>
<tr>
<td><strong>SEPT</strong></td>
</tr>
<tr>
<td><strong>9:00</strong></td>
</tr>
<tr>
<td><strong>staff meeting</strong></td>
</tr>
<tr>
<td><strong>11:00</strong></td>
</tr>
<tr>
<td><strong>call Peter (10:45)</strong></td>
</tr>
<tr>
<td><strong>11:45</strong></td>
</tr>
<tr>
<td><strong>12:00</strong></td>
</tr>
<tr>
<td><strong>1:00</strong></td>
</tr>
<tr>
<td><strong>1:30</strong></td>
</tr>
<tr>
<td><strong>lunch with client</strong></td>
</tr>
<tr>
<td><strong>4:00</strong></td>
</tr>
<tr>
<td><strong>4:30</strong></td>
</tr>
</tbody>
</table>

**REMARK:**

**Figures:**
- Figure 7: The time management facility.
- Figure 8: A page of an electronic appointment book.
- Figure 9: A meeting specification form.
As a default, the value of subject will be
given as 'Meeting'. When the date and starting
time of the meeting are not specified, the sys-
tem will search for the earliest available per-
iod, starting from nine o'clock the next day,
that suits both the duration of the meeting and
all its participants. If the user does not
specify the meeting place, any one of the con-
ference rooms that is available at the time of
the meeting will be reserved.

In this example, the user indicates that he
wants a meeting concerning a budget review to be
scheduled at 1 p.m. on September 30, 1983. In
estimating the duration of the meeting, he wants
to check the agenda of the latest session of the
budget review. Therefore, he presses the button
'hold'; the facility of time management is sus-
pended, and the system returns to the main desk-
top. The user then invokes the file manage-
ment facility to retrieve the agenda of the last
budget-review meeting.

While examining the agenda, the user wants
to retrieve some budgetary data from an ib ob-
ject. He presses the key 'hold' again and the
file management facility is now suspended. All
the suspended facilities will be listed in the AI
area. After examining the required informa-
tion from the ib object, the user returns to the
main desktop by pressing the 'done' key. Depre-
sessing the key 'resume' will release the file
management facility from suspension and restore
the display at the point where the user last
left off. The message in the AI area will also
be revised accordingly.

When the user finishes estimating the
duration of the meeting, he presses the key
'done' to complete the retrieval process of the
file management facility. Returned to the main
desktop, the user may still activate any objects
for other purposes. The reminding message will
stay in the AI area until all the suspended
facilities are released. When the user presses
the key 'resume' and returns to the facility of
time management, the screen is restored as shown
in Figure 9.

Upon the completion of the meeting speci-
fication form, the meetings scheduler checks the
participants' electronic appointment books to see
if they are free for the meeting. If all
participants are available and a conference room
is accessible, the scheduler will enter the en-
gagement onto the host's and participant's ap-
pointment books and reserve the conference room
automatically. The conference room schedule will
also be updated accordingly.

In case of a time conflict, the meeting
scheduler will print a list of several time
frames (within the time period requested by the
host) that is convenient for all meeting parti-
cipants. The user then selects one of the pos-
sible choices.

9. Conclusion

The design of the proposed prototype was
accomplished in several stages. A spatial-
oriented user's conceptual model was established
first; objects in the user interface were then
defined. The interface involved two types of
objects, namely functional objects and informa-
tion objects. The representation of information
objects was in the form of graphical symbols,
the icons. The user interface provided a set of
primitive icons, from which user-generated gra-
phical images could be derived. In order to
escape the physical-size constraints of the ter-

cinal screen, the prototype design employed the
framework of a virtual display and a hierarchi-
cal structure of information spaces. The design
also included the notion of working sheets that
are created and manipulated within the virtual
terminal workspace. Finally, a set of basic
functional operations for manipulating icons was
briefly discussed.

The effectiveness of the proposed prototype
was tested in part through the specification of
detailed scenarios for three applications in [5].
Two of these applications, a file manager and
meeting scheduler, were outlined in this paper.

Future work involves the completion of a
prototype implementation and the testing of the
effectiveness of this prototype on a realistic
user community. A viable prototype implementa-
tion strategy that we are currently investigating
is to build an information-space model on top of
an existing integrated OIS software packaged such
as Knowledge Man [6].

BIBLIOGRAPHY
[1] Durrett, J. and Trezona, J.:'How to Use
Color Displays Effectively," Byte, vol. 7, no. 4,
April 1982, pp. 50-53.
Systems and Computer Science," Computer Survey,
vol. 12, no. 1, March 1980, pp. 27-60.
and Traub, W.G.:"A Master Communications System,"
402-431.
Proceedings of the NYU Symposium on User Interfaces,
Interface Prototype for Office Information
Systems," Master Thesis, Dept. of Comp. Science,
University of Saskatchewan, September 1983.
Information Management System," Micro Data Base
[7] Sneiderman, B.:"The Future of Interactive
Systems and the Emergence of Direct Manipulation,"
Proceedings of the NYU Symposium on User Inter-
[8] Sneiderman, B.:"Direct Manipulation: A Step
16, no. 8, August 1983, pp. 57-69.