
The Palm Zire 71 Camera Interface

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Abstract

In late summer of 2002, the Palm Human Interface (HI) Team was given four months to design a digital camera interface for the Palm Zire 71 handheld computer. The project required an unusual amount of coordination between HI, product management, engineering, and hardware industrial design (ID) to find ways to extend digital photography conventions into the context of the Palm OS and the not very camera-like form factor of the typical Palm device.

This case study shows the evolution of the camera interface over the entire development period, placing design decisions in context with larger product developments. Discovery was minimal, user testing nonexistent, and there are no published results. In other words, this case study describes how an elegant human interface design gets created under real (i.e. unreasonable) deadlines and with typical (i.e. nonexistent) resources.

Keywords

Concept Design; Design Planning; Industrial Design; Interaction Design; Product Design; Usability Research; User Interface Design

Industry/category

handheld computing; digital photography; consumer electronics; personal information management; PIM; PDA; entertainment; graphics

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NOTE: As of October 2003 Palm, Inc. has been officially known as palmOne, Inc. The name "Palm" will be used in this document for historical reasons only.

Project/problem statement

Palm, Inc. is the leader in handheld computing. In 2002, Palm introduced two new product lines: Zire and Tungsten. The Zire line is targeted at individuals and small businesses looking for simple, elegant personal information management (PIM) solutions. The Tungsten line is targeted at mobile professionals requiring powerful computing and wireless email and Internet capabilities in a handheld computer.

In 2003 the Zire 71 introduced high-resolution color, performance, and media features to the consumer product line. This case study documents the design of the Zire 71 built-in digital camera interface.

During the 2002 product development cycle market research indicated that entertainment (games, music, and other media) would exceed PIM as the primary use for handheld computing devices among mobile consumers. The Zire 71 was therefore designed to capture and playback a wide variety of media, including MP3s and digital photographs. The target market for the Zire 71 consisted of media enthusiasts, younger professionals, and recent college graduates who all shared an appreciation for high quality, high style consumer goods.

Palm intended the Zire 71 to increase and solidify the company's share among more mainstream users by undercutting the cost of most dedicated digital cameras and MP3 players while also providing "serious" PIM functionality that the other devices couldn't match.

The Zire 71 built-in camera was not intended to be a user's primary digital camera but was designed for "capturing and sharing life's moments instantly," the

same spontaneous behavior seen in users of cell phone digital cameras. But unlike cell phones the Zire 71 allows users to easily manage and organize photos and then transfer them to and from the user's desktop computer.

Background/Project participants

The Zire 71 camera interface development team consisted of the following Palm employees:

Ron Fernandez
Senior Human Interface Design Engineer
Responsible for interaction and visual design of the camera application.

Raj Doshi
Core Software Product Manager
Responsible for product and customer market requirements.

Eric Klein
Manager, Core Software Product Management
Responsible for product and customer market requirements.

Alexander Roux
Manager, Platform Application Engineering
Responsible for application development and hardware integration.

Project dates and duration

Within the context of the larger Zire 71 project, the camera interface design project began in early August 2002. Final interface design specifications and graphic resources were delivered in November 2002.

Challenge

Palm devices share a fairly common form factor—a square or rectangular screen, two to four application buttons and, since 2002, a five-way controller. These hardware conventions have strongly influenced the design of Palm OS software. But at the beginning of the camera interface design project no one knew how the addition of camera hardware would affect the industrial design (ID) of the Zire 71. How would the user hold the Zire 71 when taking a photo? Would there be a shutter button? If the Zire 71 didn't have a dedicated shutter button could another button do dual duty and act as a shutter button when the camera was active? What about an onscreen shutter button? Would photo quality be affected if the user had to tap the screen (and possibly jiggle the device) in order to take a photo? Would it be difficult to frame a photo if the user's hand partially blocked the screen when tapping an onscreen shutter button? Where would the lens be located? Would the camera have to turn off frequently to save power? How would this affect user experience?

These important questions about the product ID remained unanswered for many weeks even as the camera interface design was being driven by a shorter software development schedule.

The worst constraint was the lack of time—the camera interface was developed in less than four months. We were unable to meaningfully test any camera interface designs before they were implemented as part of the alpha-level product release. With paper prototypes testers had trouble imagining the dynamic behavior of a camera interface and the relationship between onscreen and hardware controls. Developing fully animated onscreen prototypes would have helped, but

working Zire 71 hardware prototypes weren't available within the software development timeframe.

The Zire 71 camera interface development team just had to rely on professional interface design experience, knowledge of the Palm OS, and common sense.

Solution summary

The Zire 71 camera interface development team quickly agreed on the following design goals:

- To follow, whenever possible, interface and interaction conventions already established by digital cameras. There was no compelling reason for Palm to introduce new interactions for digital cameras unless absolutely required by features or limitations of the Palm OS.
- To make no assumptions about the final Zire 71 ID since the ID development schedule lagged the camera software schedule by several weeks.
- To remain flexible enough to change the camera interface if, as the ID progressed, opportunities arose to better integrate the hardware and camera software.
- To seamlessly integrate the camera with Palm Photos, an application that comes standard with most color Palm devices and which provides photo and photo album management features

See the **Solution Details** section to see how these design goals and the ongoing hardware development process affected the evolution of the Zire 71 camera interface.

HARDWARE OVERVIEW: Final design



When closed the Zire 71 looks like a typical Palm device. Pressing any of the four buttons on the face of the device opens the corresponding application. The 5-way controller gives users the ability to select applications and look up information without using a stylus.

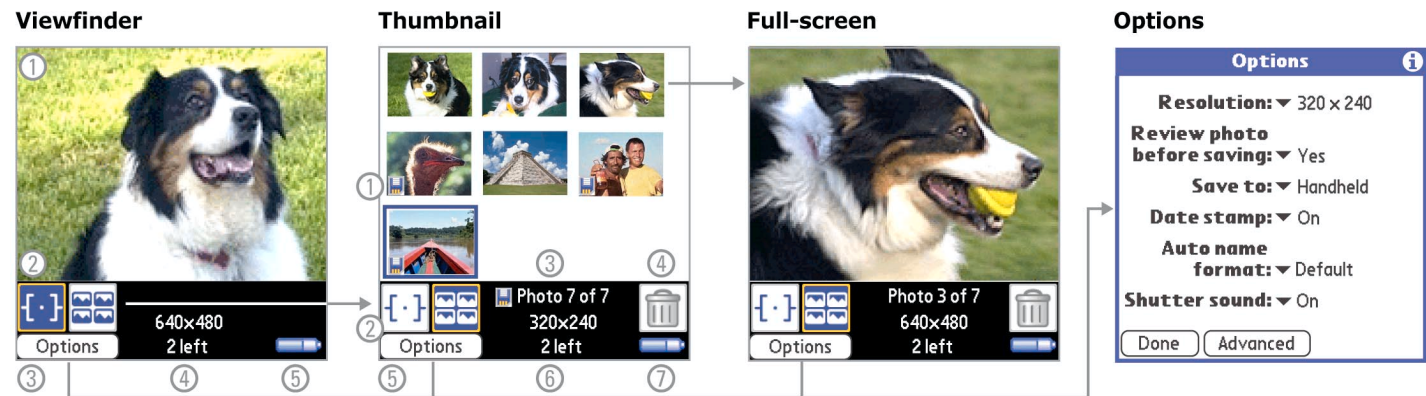
User opens the Zire 71

The camera application launches automatically when the user slides opens the Zire 71 by pushing on the handheld just below the 5-way controller. The application buttons are deactivated while the camera is active. The user presses the shutter button to take a photo. The user can delete a just-taken photo during the optional three-second review period.

User closes the Zire 71

The camera application does not save any photos from session to session. All photos are automatically named (see pages 12-13 for more information on naming) and are saved to the Palm Photos application. The user can upload photos to his or her desktop computer with the Palm HotSync (synchronization) feature.

CAMERA OVERVIEW: Final design



The figure above shows the key features and interactions of the shipping version of the Zire 71 camera application.

Viewfinder

1. Live image
2. Viewfinder and thumbnail view buttons
3. Options button
4. Current resolution, save-to location icon (if needed), and number of photos left on current save-to location
5. Battery level

Thumbnail view

The thumbnail view shows all photos taken during the current session. The user can navigate this view using the 5-way controller button.

1. Save-to expansion card icon (if needed)
2. Viewfinder and thumbnail view buttons

3. Save-to location, number, and resolution of the selected thumbnail
4. Delete button
5. Options button
6. Current save-to location and number of photos left
7. Battery level.

Full-screen view

This view has the same features as the thumbnail view.

Options dialog

The user can change camera options at any time. Changes are applied to all subsequent photos. Tapping the Advanced button displays contrast, brightness, and white balance controls. See pages 12-13 for a detailed description of the development of the Options dialog.

Solution details

Because the Zire 71 was intended to be a multi-purpose handheld computer the camera interface design team could not assume the device would have any camera-specific hardware except for an optical lens. Digital camera controls such as shutter buttons or zoom settings were implemented onscreen in early versions of the Zire 71 camera interface design (see pages 8-10). These onscreen controls would evolve or disappear as the Zire 71 product ID developed.

In the final design, the user activates the camera by sliding open the Zire 71—there is no camera application icon on the main screen. The Zire 71 remains in camera mode and all application buttons are disabled until the user closes the device. New photos are then automatically saved to Palm Photos and the hardware application buttons are reactivated.

There was a significant usability reason why the camera application had to save photos to the Palm Photos application—the camera design team did not want two photo databases on the Zire 71. Because the Palm OS does not have a hierarchical file system neither the camera application nor Palm Photos would have been able to see photos stored in the other application. If the user didn't know to look in both applications it might appear that photos were being lost.

Deactivating the four application buttons was a significant departure from Palm conventions. There are no Open, Save, or Quit commands in the Palm OS. If the hardware buttons and the camera were both active at the same time a user could press a hardware button and open a second application (e.g. Address Book) before any new pictures had been saved to Palm

Photos. This would have violated the previous goal of having only one photo database.

DESIGN DELIVERABLES

The Palm Human Interface Team typically follows a five-step design process—discovery, concepts, design, test, and specifications. Much of the process was skipped during the Zire 71 camera project due to time constraints.

Discovery consisted of using three different digital cameras over the course of two days. Concepts consisted of quick notebook sketches.

During the design phase the Palm Human Interface Team creates flowcharts to present interface proposals and document agreed-upon designs, issues, and assumptions. The final flowchart for the Zire 71 camera design was nine pages long. It documented the most common user interactions and showed all dialog and menu text and included pixel-level specifications. Bitmap graphic resources were delivered to engineering as separate files. The examples in this case study use screens taken directly from Zire 71 camera design flowcharts (see page 7).

A NOTE ON DESIGN DELIVERABLES

The Palm flowchart format conveys, in print, the basic experience of using an application. Handheld screens in flowcharts are typically one-half to one-third the size of actual Palm handheld screens.

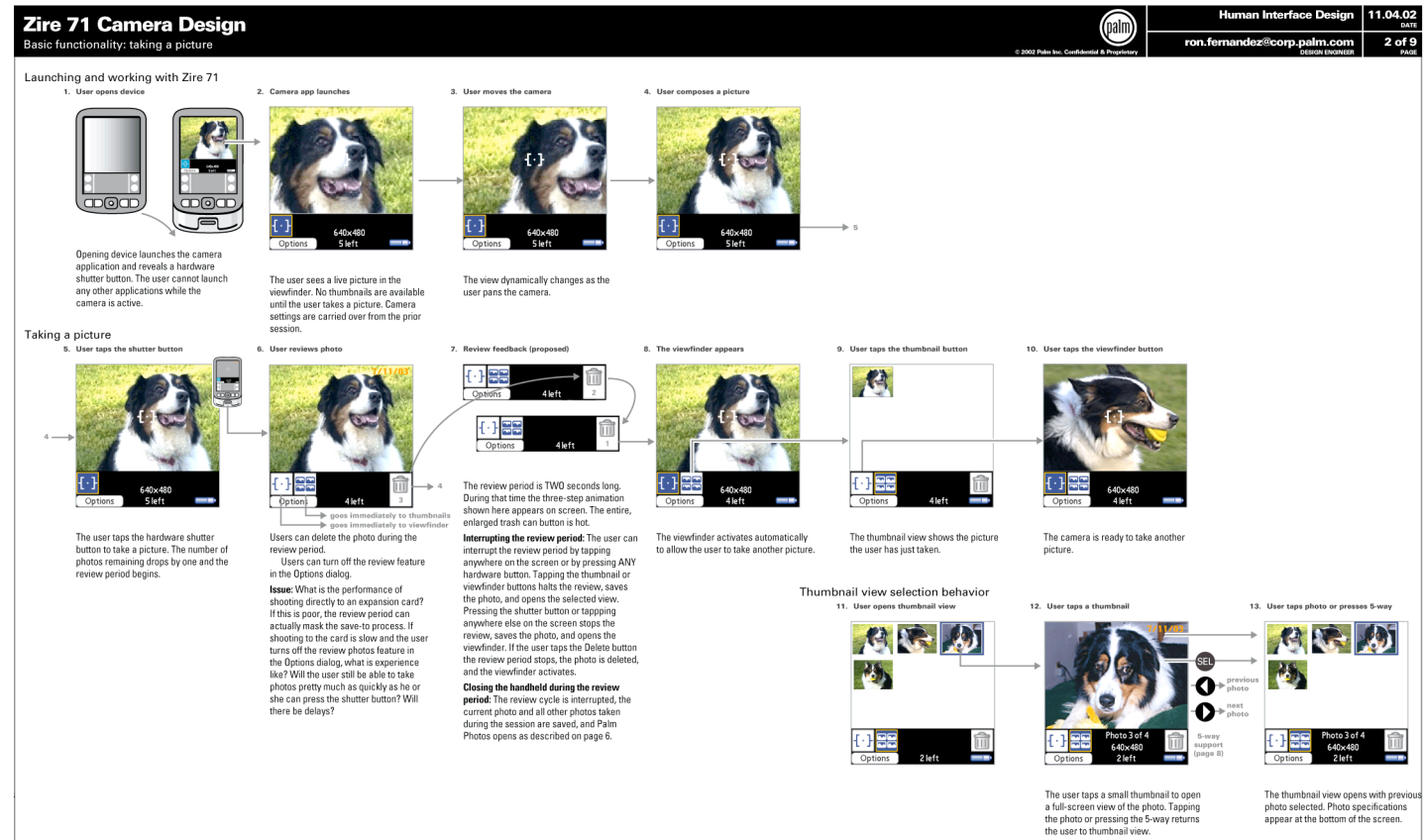
Because of the small size of flowchart screen graphics, the original set of sample photos for the Zire 71 camera flowcharts were chosen solely for maximum visual contrast and were not intended to be indicative of the

photos users would eventually take with the shipping product. Early flowcharts showed photos of an autumn street scene, a shark, an Apollo astronaut, and a U.S. president shaking hands with a famous rock star.

This led to a surprising amount of initial confusion among engineers and product managers who patiently pointed out to the Human Interface team that the

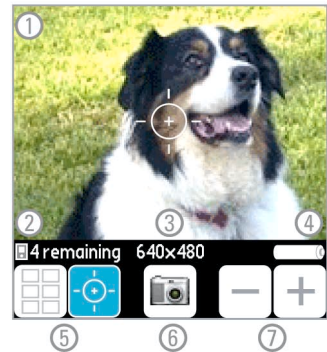
Zire 71 was not intended for use underwater, in outer space, nor could it take pictures of events in the past.

November 4, 2002
Page two of the final Zire 71 camera interface flowchart with less confusing sample photos.



Zire 71 CAMERA DESIGN: Initial proposal
August 16, 2002

Viewfinder



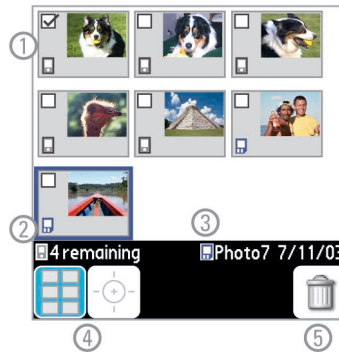
Viewfinder

1. Viewfinder has cross hairs.
2. The save-to location (device or expansion card) is indicated by icons in all views. Photos remaining are determined by free memory.
3. Current resolution
4. Battery level appears in the viewfinder because the user cannot go to the Palm OS main screen to see battery level while the camera is active. (See main screen on closed Zire 71 on page 4 for reference.)
5. Thumbnail view and viewfinder buttons. Thumbnail button is in the same location as in Palm Photos.
6. Onscreen shutter button
7. Digital zoom controls

Thumbnail

1. Thumbnails. Check boxes allow multiple selection and deletion.

Thumbnail



Full-screen



2. Current save-to location and photos remaining
3. Save-to location and auto-generated name of selected thumbnail
4. Thumbnail view and viewfinder buttons
5. Delete button.

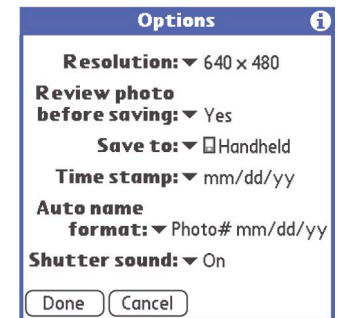
Full-screen

1. Photo x of y photos taken
2. Save-to location and auto-generated name of current photo
3. Resolution of current photo
4. Thumbnail view and viewfinder buttons
5. Delete button

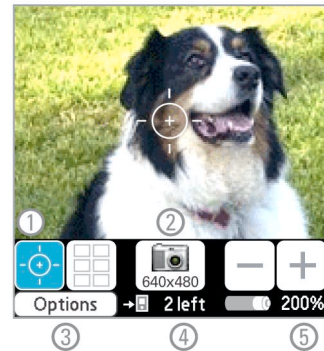
Options

See pages 12-13 for a detailed description of the development of the Options dialog.

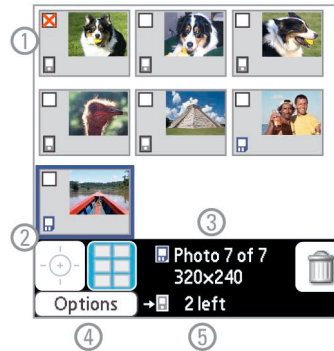
Options



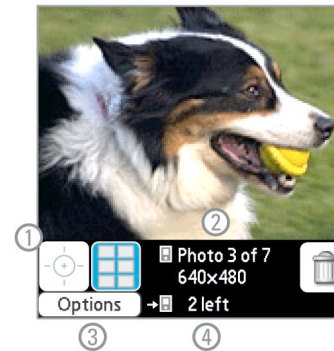
Viewfinder



Thumbnail



Full-screen



Factors affecting design

- Onscreen buttons placed directly beneath the image in all views.
- User-controlled camera options shouldn't be in a hidden menu. An Options button is added to all views.
- Users need current save-to location and photos when taking or deleting photos. Info added to all screens.
- Pressing the 5-way controller now takes a picture. Users select thumbnails by pressing the 5-way controller right, left, up, or down. In full-screen view users move between photos by pressing right or left.

Viewfinder

1. The viewfinder is the most important view. View buttons are swapped.
2. Adding the Options button takes up space. Resolution moves to shutter button graphic.
3. Options button added

4. "Left" replaces "remaining" to save space (at least in English)
5. Zoom factor added

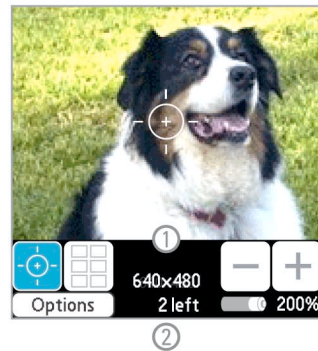
Thumbnail

1. Check boxes on thumbnails use red X's to follow Palm Photos deletion interface
2. View buttons are swapped.
3. New specifications format for selected thumbnail
4. Options button added
5. "Left" replaces "remaining" to save space

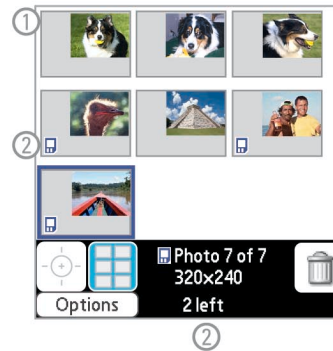
Full-screen

1. View buttons are swapped
2. New specifications format for current photo
3. Options button added
4. "Left" replaces "remaining" to save space

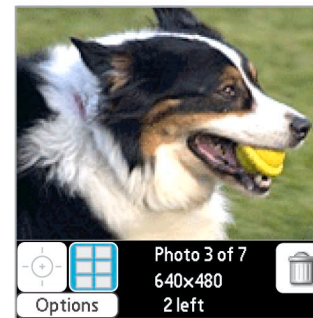
Viewfinder



Thumbnail



Full-screen



no changes

Factors affecting design

- Decision made to add a hardware shutter button to the Zire 71 ID.
- Save-to location will be indicated with an icon when saving to an expansion card only. No icon will be displayed when saving to device memory.
- Interface design seems solid enough to begin development of graphical interface elements and pixel-level specifications.

Viewfinder

1. On-screen shutter button removed due to addition of hardware shutter button
2. Save-to location is indicated by an icon when saving to an expansion card only

Thumbnail

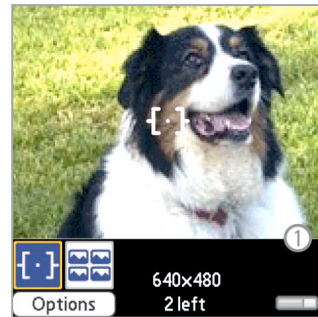
1. Interaction with early hardware mock-ups suggests that users will not take many pictures during a session (i.e. before they close the Zire 71 and photos are saved to Palm Photos). Therefore multiple selection is no longer needed and check boxes are removed.
2. Save-to location is indicated by an icon when saving to an expansion card only.

Full-screen

No changes from previous design iteration.

Zire 71 CAMERA DESIGN: Final design
November 4, 2002

Viewfinder



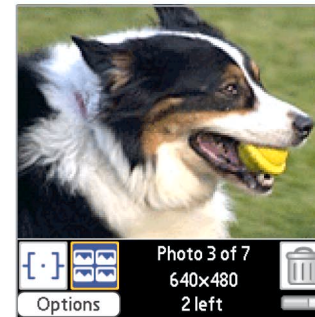
②

Thumbnail



②

Full-screen



②

Factors affecting design

- In the intervening month the Human Interface team develops 1-bit, 8-bit gray, and 8-bit color graphic resources in both low- and high-res versions (shown in examples above). Engineering implements interface specifications and graphics to meet alpha product release requirements.
- Hardware engineering determines that the Zire 71 camera mode will consume relatively high amounts of power in all views, not just the viewfinder. Battery level is added to all views.

Viewfinder

1. Early hardware tests show that the quality of the digital zoom effect won't meet specifications. Digital zoom controls removed.
2. Zoom factor removed and battery level moved to the right

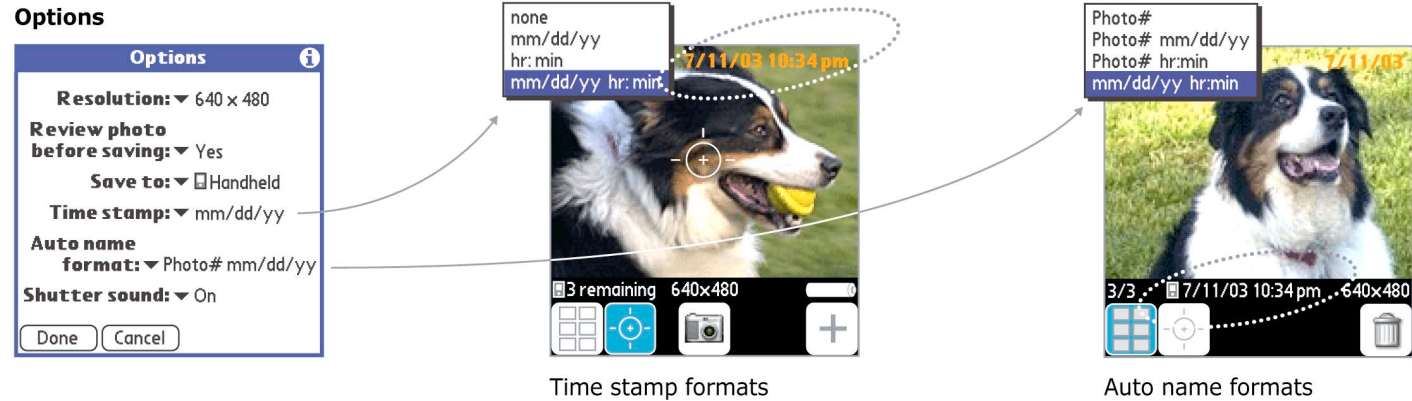
Thumbnail

1. Multiple selection and check boxes were removed in the previous design iteration. Most photos will be saved to device memory and no save-to icon will be shown. This leaves room in the grid to increase thumbnail size.
2. Battery level added

Full-screen

1. Battery level added

Zire 71 OPTIONS DIALOG: Initial proposal
August 16, 2002



Most Options dialog features are self-explanatory. The time stamp, auto name format, and Advanced controls underwent the most change during the interface development process.

The first versions of the Options dialog did not have an Advanced button. Hardware engineering was not sure they could provide software control of camera settings such as brightness and contrast.

Time stamp

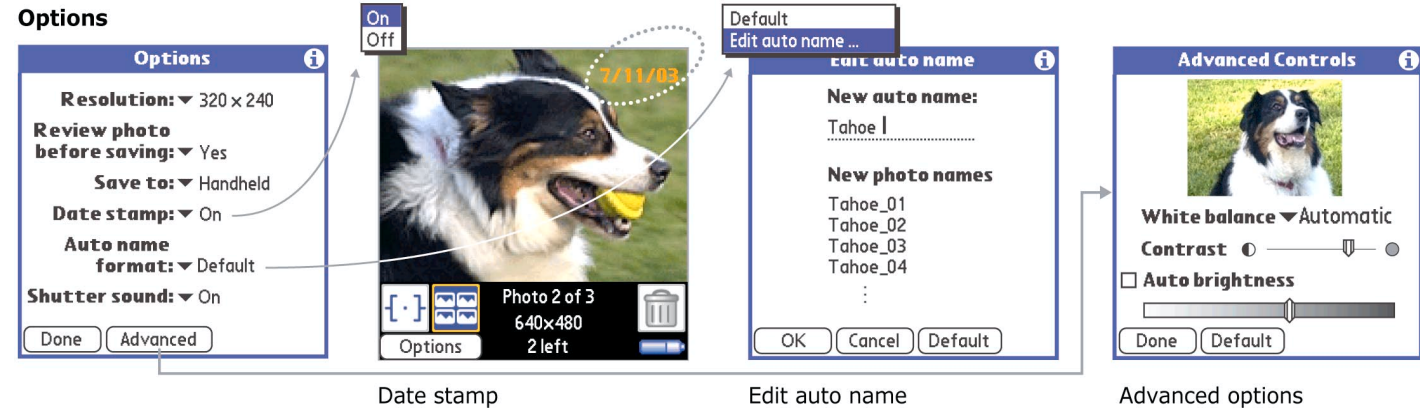
The user can choose from the three pre-set time stamp formats shown in the pop-down menu. The default time stamp option is None.

Auto name format

Digital cameras must automatically and uniquely name the photo files they create. But most auto name formats do nothing to help the user identify a specific photo or range of photos in a list view. In this one area the Zire 71 camera improved on current digital camera conventions by actually naming photos in a unique and, to the user, helpful way. The auto-formatted names would appear in the Palm Photos application list view. The names would also appear on the image files after photos were uploaded to the user's desktop computer.

The initial design specification provides four pre-defined auto name formats as shown in the pop-down menu.

Zire 71 OPTIONS DIALOG: Final design
November 22, 2002



Date stamp

The time stamp feature is simplified and follows the user-selected operating system date format.

Auto name format

The original proposed auto name formats were difficult to understand in long list views, especially when multiple formats were included in the same list. In the final design photos are auto named by set number, photo number in the set, and date as follows:

setx_y dd/mm/yy

The user creates a new set whenever he or she opens the Zire 71 and takes any number of pictures. Closing the device saves that set of pictures to Palm Photos. The set number "x" increments continually over the life of the device, the photo number "y" resets to 1 with

each new set, and the date is determined by the internal clock. The date helps a user find a photo taken, for example, during vacation. The set number indicates whether the photos were taken relatively earlier or later in the day.

The user can edit the auto name format. The photo number "y" is appended to the new auto name. In a list view, a custom auto name format looks like:

<custom name>_y dd/mm/yy

Advanced

Tapping the Advanced button opens a dialog containing a live image preview and white balance, contrast, and auto brightness controls.

Results

The Zire 71 shipped in spring 2003 and has received uniformly positive reviews and the user response has been excellent. It would be impossible, however, to try and assign a specific percentage of the success of the Zire 71 to the built-in camera. The product was designed to offer a rich feature set and the combination of ID, memory, and media features that appeals to any given user is unique. Nevertheless, the camera is consistently the first feature mentioned in Zire 71 reviews and it plays a large role in Palm's own marketing efforts for the product.

Typical review comments include:

- InfoSync
The Zire 71 is an excellent device. We're disappointed by the lack of Bluetooth, poor stylus, and the pointing stick Navigator, but the good camera, mouth-watering screen, and excellent software integration win us over.
<http://www.infosyncworld.com/reviews/n/3460,2.html>
- PC Mag
The Palm Zire 71 is an exciting, economically priced multimedia PDA that effectively integrates ease of use with multimedia features.
<http://www.pcmag.com/article2/0,4149,1040088,00.asp>

POST-LAUNCH ANALYSIS

The Zire 71 camera design project was not an example of process excellence. The discovery or research phase of the design process was perfunctory at best and concept development was limited to a few notebook sketches. User testing eventually took place with beta quality hardware and software. Results were very good,

but testing was so late that we would have slowed development for nothing less than fatal errors.

But the project was an excellent example of why understanding and following process—whenever possible—is important. The Zire 71 camera design team would not have been successful had we not been able to refer, as needed, to the official Palm HI development process for already-understood practices, procedures, deliverables and standards. This facilitated communication between team members and, perhaps most importantly, with groups outside of the core team.

As for the camera application itself, perhaps the only real missed opportunity was an aesthetic one. Historically one of the key usability features of the Palm OS has been its stripped down, bare visual design, which is extremely legible on low-resolution, poorly-backlit screens. But the tension between visual aesthetics and strict usability requirements in software design has been exacerbated in recent years by the addition of high-resolution color screens to all sorts of consumer devices, especially cell phones, video games, and handheld computers. It wasn't surprising, therefore, when early in the Zire 71 camera project senior product management and engineering managers began pushing for a more "friendly, cool, consumer-look." When pressed for details it became clear management believed recent Apple Mac OS X applications were the standard to meet.

Stories about people who confuse icon design with interface and interaction design are cliché in this industry. The Palm HI Team typically refuses to address specific aesthetic issues during the concept and early design stages of any project. Unfortunately this policy,

combined with the accelerated development period, meant that comprehensive aesthetic exploration was put off until it was too late to incorporate into the shipping version of the camera application. As a consequence the final version of the interface isn't significantly different visually from the earliest design proposal (compare pages 5 and 8).

The Palm HI Team had been preparing to explore how color and high-resolution displays could improve both the usability and look of core Palm applications when the Zire 71 camera project began. But there was no time to develop even a basic set of new design guidelines within the camera application development schedule. And there was some concern about setting aesthetic precedents with the Zire 71 camera application that weren't extensible to new and existing applications.

In retrospect we should have taken a few aesthetic risks and not worried whether the Zire 71 camera visual design proved to be a one-off or not. The camera application is a simple to use, functionally elegant application but it looks a little conservative in the context of the striking Zire 71 product ID.

Acknowledgements

The entire Palm Human Interface Team—Mark Davis, Manager and senior human interface design engineers Sce Yun, Carlo Bernoulli, Adam Donkin, and Chris Daniels—provided insightful, detailed, and sometimes brutal criticism in a timely manner. Their input was key to the final design of the Zire 71 camera application.

Adam Donkin gets special kudos for his work on the Palm Photos application. His simple, elegant design proved very easy to integrate into the Zire 71 camera application experience.

Lawrence Lam, Manager of the Palm Industrial Design Team is responsible for the slick, sliding action of the Zire 71. This is one of those "wow" features that, when using the device, never fails to delight

The extended Zire 71 hardware and software engineering teams did an exceptional job integrating a host of new features and setting great precedents for quality and performance of future Palm devices.