are arranged to support the external screen in its extended position, and a retracted position, in which they lie closer to the housing of the cell phone than in their extended position.. For example, the support members could fold out from the housing when the external display is in use. Such retractable support members have the advantages of being less susceptible to damage while the cell phone is not in use, and also reduce the bulk of the phone when not in use.

[0029] The external screen may draw power solely from a battery located within the cell phone, eliminating the need for a separate battery, although the external screen could of course have its own battery if desired. Desirably, the electro-optic medium used in the external screen should draw power primarily during image update so that the screen is primarily drawing no power even while the user is reading. In this connection, the bistable nature of some electro-optic display media, as discussed in detail below, greatly reduces the power requirements of the external display. The external screen typically will contain row and column drivers and in some cases a separate controller.

[0030] The external screen may be used purely for output (data display), but it could be provided with a least one manually-operable data input means, for example a touch-screen or one or more push buttons. Alternatively or in addition, the data input means could comprise a pointing device, for example a small trackball. One preferred external screen device variant of the invention uses a simple sequence of four to eight buttons along one side of the external screen in a manner similar to that commonly used for automated teller machine (ATM's) displays, personal digital assistants (PDA's), or handheld computers, thus permitting a useful degree of interactivity. A jog dial or a mouse may be used to select options or scroll between pages. However the external screen device need not have any buttons, relying on the cell phone inputs for selection and control.

[0031] As already indicated, the electro-optic medium used in the present external screen device is desirably bistable, so that it only draws power as the screen is being redrawn. (The terms "bistable" and "bistability" are used herein in their conventional meaning in the art to refer to displays comprising display elements having first and second display states differing in at least one optical property, and such that after any given element has been driven, by means of an addressing pulse of finite duration, to assume either its first or second display state, after the addressing pulse has terminated, that state will persist without power for at least several times, for example at least four times, the minimum duration of the addressing pulse required to change the state of the display element. Some electro-optic media are capable of gray scale and are stable not only in their extreme black and white states but also in their intermediate gray states. Thus, this type of display is properly called "multi-stable" rather than bistable, although the latter term may be used for convenience herein.) The electro-optic medium is also desirably reflective rather than transmissive, since this eliminates the need for a backlight, and thus the power drain associated with such a backlight.

[0032] To achieve legibility in typical office lighting conditions, the reflective display should have a reflectivity of at least one-third the brightness of white paper and a contrast ratio of at least 6 to 1, similar to newspapers, but ideally 10 to 1 or better. Ideally the display should be such that it can be used as a source for typical copier machines, so that a mobile worker could access a document, copy it from the external display using a standard copier, and thereby obtain printouts with good resolution and readability.

[0033] The external screen device of the invention may function as both a cell phone and a PDA. Many PDA's are today being provided with cell phone capability. However, an external screen device of the present invention permits PDA functions to be added to a cell phone, and web software used to permit the user to access PDA functions such as address book and calendar over a network. Thus, the cell phone and external display together make a cheap, thin mobile client that can nevertheless benefit from intense computations or large-scale database access back on the server end.

[0034] The external display screen may be attached to the cell phone by any suitable physical means and using any suitable protocol. For example, the cell phone may serve as a universal serial bus (USB) master and the display device as a USB slave. This permits the device to access both data and adequate power in a well-defined and cross-device standardized way at a low incremental hardware cost. Furthermore cell phones with USB masters could drive data to many other peripherals including large electronic ink signs and many multimedia devices. In addition, USB or similar standards permit a large number of devices to be daisy-chained or networked to a single cell phone in an easy manner so that all the devices can share one external network access point.

[0035] While USB is a more elegant solution, serial lines, IIC, and 8-bit parallel are the current standard communication methods for cell phones, and these may also be implemented in the present invention.

[0036] Providing an external screen with a common resolution such as VGA would enable many wireless application providers to all write to a common standard. Support for a common markup language such as HTML or XML would enable many types of external portable screens to exist and to benefit from the same wireless applications, spawning a new class of cell phone peripherals.

[0037] In the external screen device of the present invention, the external screen may be detachable from the cell phone, and/or may be supplied as an after-market accessory which can be temporarily or permanently attached to a cell phone. Desirably, the external screen is provided with a mechanism which provides universal attachment of a small ("pocket sized") external screen to the side of a cell phone so as to facilitate single handed use of the system. For example, a plastic slide track piece with an adhesive back may be sold with the screen. The slide track is attached to the side of the cell phone when the user wishes to add the external screen functionality. The track can be made low profile so that it does not materially impact the form factor of the original cell phone. The edge of the external screen (or part of the top half of the edge) may be designed so it can be easily slid, secured, and removed from the track.

[0038] Also a cable for the external screen can be spooled within the footprint of the unit so as to preserve portability and avoid mishandling during transport. The advantages of this approach are: 1) universality, 2) simplicity, 3) low cost,