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(54) **METHOD FOR SIMULATING SCREEN SHARING FOR MULTIPLE APPLICATIONS RUNNING CONCURRENTLY ON A MOBILE PLATFORM**

(76) Inventors: **David Beilis**, Maple Ontario (CA); **Adrian Lee-Kwen**, Ontario (CA)

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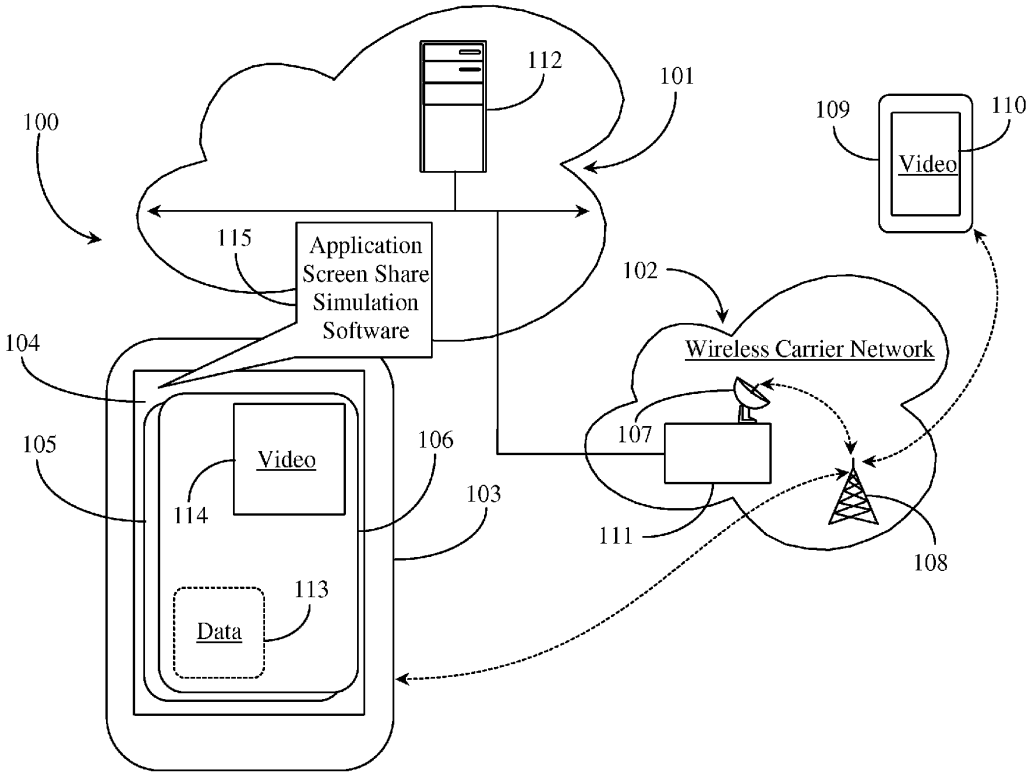
(57) **ABSTRACT**

A system for sharing a physical display screen among multiple applications on a mobile platform includes an Internet-connected client device and software executing on the client device from a non-transitory physical medium, the software providing a first function assigning dominancy to one of the multiple running applications, a second function mitigating application background transparency among the multiple running applications, a third function establishing a messaging mechanism and protocol between the multiple running applications, and a fourth function enabling the dominant application to intercept digital input directed toward individual ones of the multiple running applications and to dispatch the input to the appropriate application.



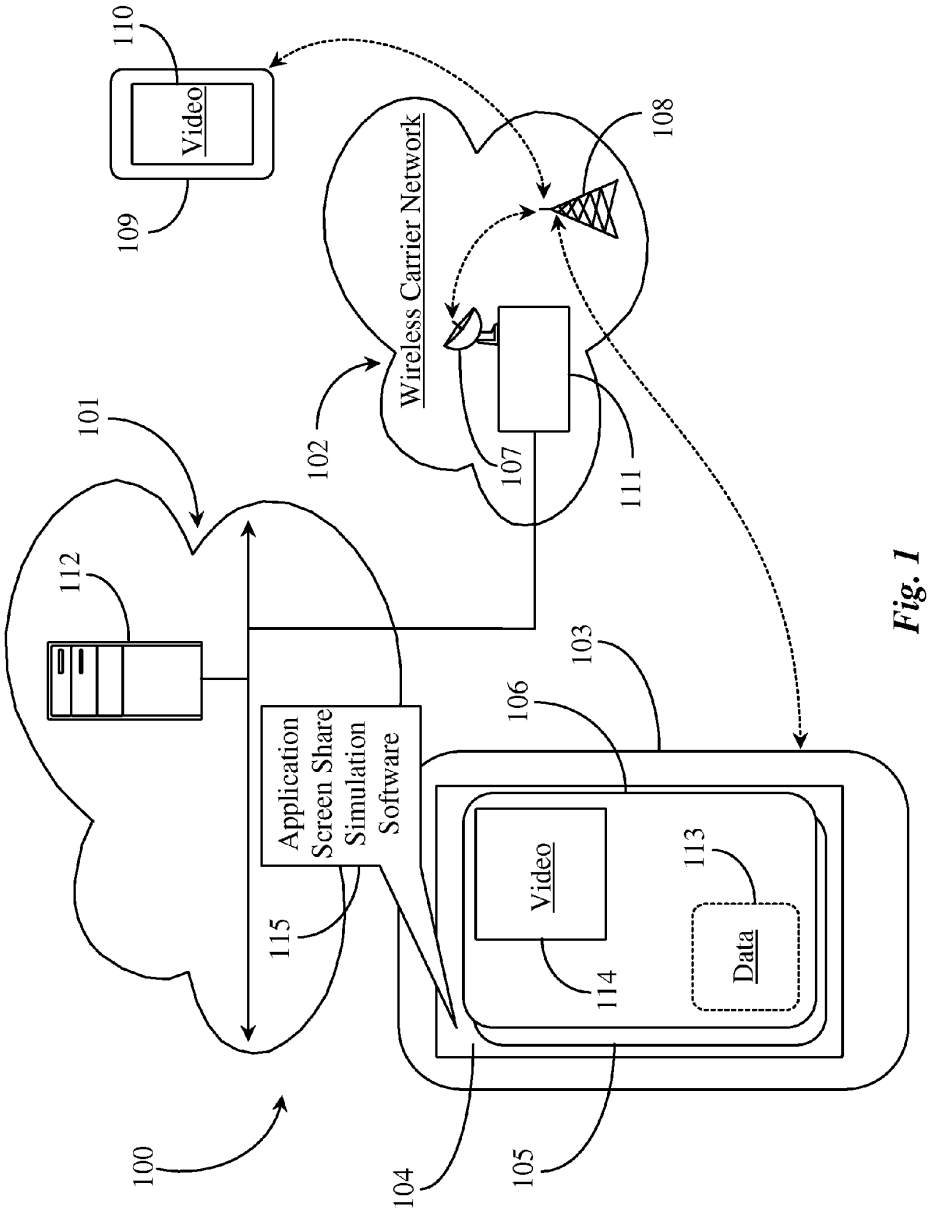

100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
Video
Wireless Carrier Network
Application Screen Share Simulation Software
Video
Data

Fig. 1

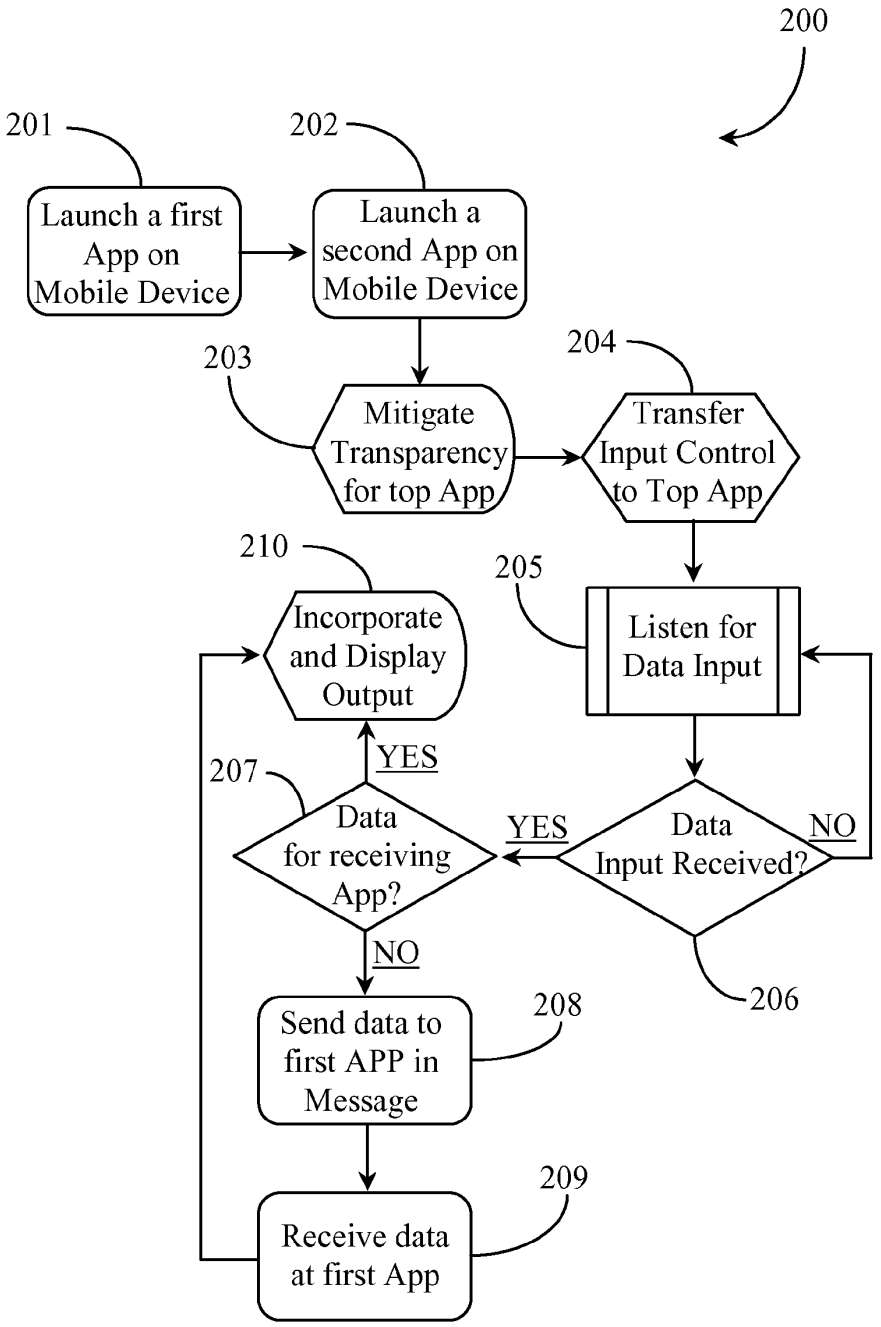

200
201
Launch a first App on Mobile Device
202
Launch a second App on Mobile Device
203
Mitigate Transparency for top App
204
Transfer Input Control to Top App
205
Listen for Data Input
206
Data Input Received?
YES
NO
207
Data for receiving App?
YES
NO
208
Send data to first APP in Message
209
Receive data at first App
210
Incorporate and Display Output

Fig. 2

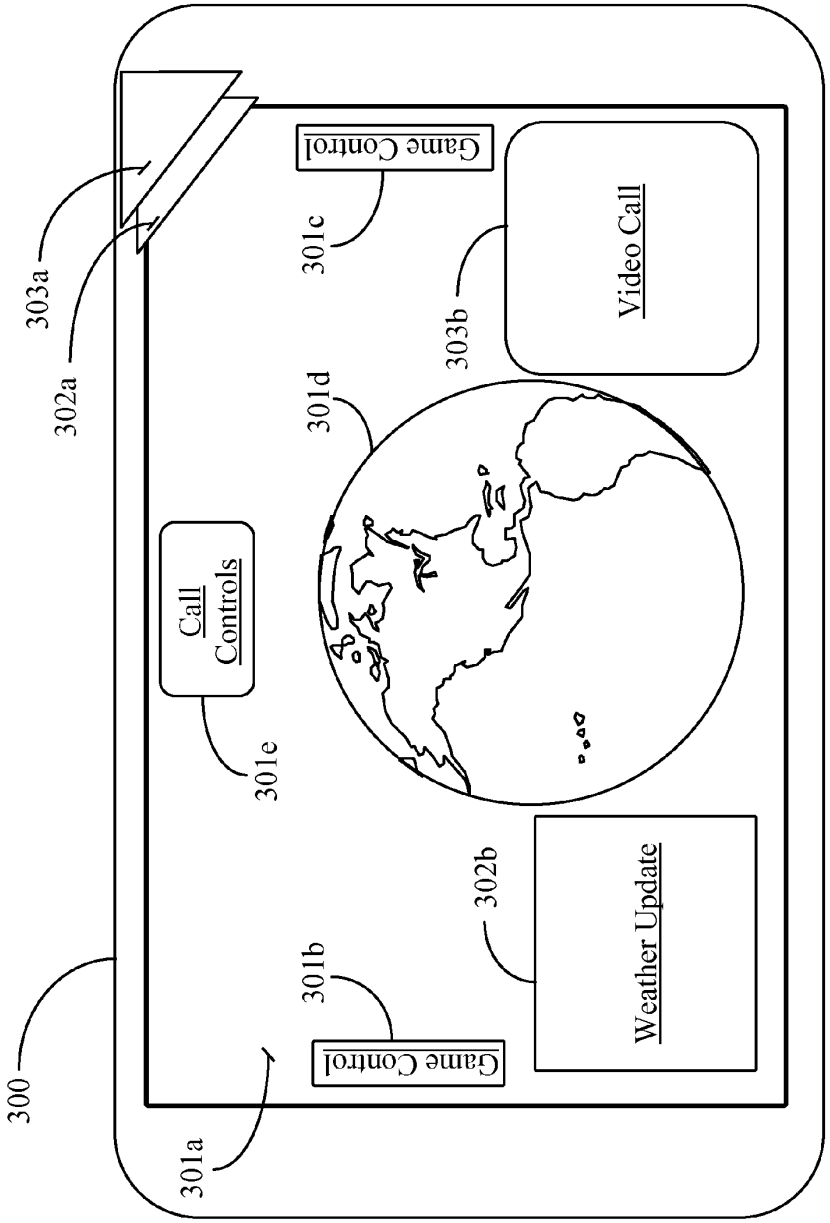

300
301a
Game Control
301b
302b
Weather Update
Call Controls
301e
301d
302a
303a
Game Control
301c
303b
Video Call

Fig. 3

METHOD FOR SIMULATING SCREEN SHARING FOR MULTIPLE APPLICATIONS RUNNING CONCURRENTLY ON A MOBILE PLATFORM

CROSS-REFERENCE TO RELATED DOCUMENTS

[0001] NA

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention is in the field of mobile communications and networking and pertains particularly to methods and apparatus for simulating physical screen sharing for multiple running applications on a mobile computing platform.

[0004] 2. Discussion of the State of the Art

[0005] In the field of mobile communications, hand-held computing appliances are available that provide user-access to the Internet and facilitate network and telephony communications. More recently a Linux-based platform called the Android mobile platform has been developed for mobile computing. On the Android platform as well as on other mobile computing platforms, the dominant running application assumes entire control of the physical display screen on the mobile device. Other applications that may be loaded (executed) and running on the device sit in the background in a passive state until manually selected as the top application.

[0006] There are some applications that contain multiple separate windows that receive and display updated information such as home screen widgets on the Android platform and Pop-up intent windows like the voice recognition intent provided by Google™

[0007] Home screen widgets on the Android platform and other summary display pages (web pages) are simple snapshots of dynamically updated data. One limitation with widgets is that they are dependant on a home screen. Any one of these widgets expanded takes up the entire physical display. The voice recognition intent application by Google™ assumes control over the entire physical display leaving any other running application in a passive state.

[0008] In mobile computing, there is a desire to allow multiple independent applications to run in parallel wherein those running applications may update the physical display simultaneously. The Android framework includes the concept of forming "Intent" which also includes key/value pairs of messages allowing for requests and responses between applications. For example, it is a common practice to send an intent to a native dialer application from another running application to implement calling functionality. Another example may be using native email application to send a new email. A limitation with the current technology dictates that only a single application may control the entire physical display on the mobile appliance. To work with and display information from non-active applications executed and running on the device, a user must select the application and engage in manual task performance to replace the original display with new data from the other application.

[0009] Therefore, what is currently needed in the art is a system and methods for simulating physical screen sharing among multiple running applications on a mobile device. Such a system would improve efficiency and reduce overall task performance requirements of the user.

SUMMARY OF THE INVENTION

[0010] A problem stated above is that visual access to updated information is desirable for a mobile platform running two or more applications, but many of the conventional means for presenting the information for display, such as by navigating tabs and manual update selection, also create more task performance requirements. The inventors therefore considered functional elements of a mobile computing platform, looking for elements that exhibit interoperability that could potentially be harnessed to provide concurrent display of updated information from two or more applications sharing a physical display screen, but in a manner that would not include more manual task.

[0011] Every mobile computing device is capable of supporting multiple running applications, one by-product of which is increased manual task performance required to manually update the applications and visualize updated display of the most recent information for any of the multiple applications. Most such mobile platforms employ software such as tabulation mechanism to enable users to switch between multiple running applications in order to visualize updated output and to perform other application tasks in accordance with the type of application selected as the dominant or active application on the device, and software is typically a part of such apparatus.

[0012] The present inventor realized in an inventive moment that if, during runtime of two or more applications that require screen space, updated information from each application could be caused to display in such a manner that all of the most recent data for each application is visible to a user regardless of which application is in use, significant manual task reduction relative to accessing updated information might result. The inventor therefore constructed a unique system for simulating sharing of a physical display screen among multiple running applications on a mobile platform that allowed the user to see relevant updates and output resulting from user input in a dynamic fashion. A significant reduction in tasks required to toggle application data display between the multiple applications results, with no impediment to efficiency or data access time created.

[0013] Accordingly, in an embodiment of the present invention, A system for sharing a physical display screen among multiple applications on a mobile platform includes an Internet-connected client device and software executing on the client device from a non-transitory physical medium, the software providing a first function assigning dominancy to one of the multiple running applications, a second function mitigating application background transparency among the multiple running applications, a third function establishing a messaging mechanism and protocol between the multiple running applications, and a fourth function enabling the dominant application to intercept digital input directed toward individual ones of the multiple running applications and to dispatch the input to the appropriate application.

[0014] In one embodiment, the mobile platform is an android platform. In one embodiment, at least one of the multiple running applications is executed by another of the multiple running applications. In one embodiment, the Internet-connected client device is an android device. In one embodiment, the application most recently executed to run is the dominant application. In one embodiment, at least one of the multiple running applications is a telephony communications application. In a variation of this embodiment, the telephony communications application enables voice and video

communications. In one embodiment, assignment of dominancy to one of the multiple running applications is a default operation. In one embodiment, the digital input is user supplied or server supplied.

[0015] According to another aspect of the present invention, a method for sharing a physical display screen among multiple applications on a mobile platform is provided and includes the steps (a) using a layered approach, stacking the applications one over another and assigning dominancy to one of the multiple running applications, (b) rendering the backgrounds of each application transparent, (c) intercepting digital input intended for one of the multiple running applications at the dominant application, (d) using a messaging protocol, sending the digital input to the intended target application from the dominant application, and (e) mitigating the transparency of the receiving application to display the output relevant to the input received in (d).

[0016] In one aspect of the method, the mobile platform is an android platform. In another aspect, at least one of the multiple running applications is executed by another of the multiple running applications. In one aspect, the Internet-connected client device is an android device. In one aspect, at least one of the multiple running applications is a telephony communications application. In a variation of this aspect, the telephony communications application enables voice and video communications. In one aspect, assignment of dominancy to one of the multiple running applications is a default operation.

[0017] In one aspect of the method, in step (c), the input includes user supplied input or input received from a server. In another aspect, in step (b), transparency is achieved using an android style command. In one aspect, in step (e), mitigation includes selecting the relevant application and removing at least some of the background transparency for display purposes. In all aspects, two or more of the applications run in parallel and display updated information visible through transparent backgrounds of overlying applications.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0018] FIG. **1** is an architectural diagram of a mobile communications network supporting simulated screen sharing of a physical display screen by multiple running applications.

[0019] FIG. **2** is a process flow chart illustrating steps for enabling simulated screen sharing.

[0020] FIG. **3** is a block diagram illustrating dynamic screen share simulation by multiple applications.

DETAILED DESCRIPTION

[0021] The inventors provide a unique system for simulating physical screen sharing among multiple running applications on a mobile appliance. The present invention will be described in enabling detail using the following examples, which may describe more than one relevant embodiment falling within the scope of the present invention.

[0022] FIG. **1** is an architectural diagram of a mobile communications network **100** supporting simulated screen sharing of a physical display screen by multiple running applications. Communications network **100** includes an Internet network **101** and a wireless carrier network **102**. Wireless communications network **102** includes a wireless Internet service provider **111**. Wireless service provider **111** includes all of the equipment and software required to provide Internet connectivity for clients connected to wireless carrier network **102**. Wireless carrier network **102** may be any wireless carrier network including cellular, wireless fidelity (WiFi), satellite network, or the like that provides communication between wireless subscribers or clients.

[0023] Wireless carrier network **102** provides connectivity for full multi-media communications and Internet access for client mobile devices **103** and **109**, for example. A cellular tower **108** and a transceiver **107** exemplify connectivity between client devices **103** and **109** and Internet connectivity for those devices via wireless Internet service provider **111**. Internet **101** is further exemplified by a network backbone representing all of the lines, equipment, and access points that make up the Internet network as a whole. Therefore, there are no geographic limitations to the practice of the present invention. One with skill in the art of network communications will appreciate that there may be multiple carrier networks including the well-known public switched telephony network (PSTN) assumed present in this example without departing from the spirit and scope of the present invention. Likewise gateways, including network bridging facilities and multimedia gateways may also be assumed present in this example without departing from the spirit and scope of the present invention.

[0024] Mobile client device **103** may be any mobile communications device capable of telecommunications and network navigation. Such devices may include a smart phone, a personal digital assistant (PDA), a notebook computer, a laptop computer, an android device, an iPad, or similar products. Mobile device **103** includes a non-transitory physical medium containing all of the software, firmware, and data required to enable function as a fully wireless communications appliance running a mobile platform such as the well-known android platform. Mobile device **103** includes a physical display screen **104**. Mobile device **105** has a first application running that uses physical display screen **104**. A second application **106** is also running on mobile device **103**. Application **106** also uses physical display screen **104**. In this example, application **106** is a telecommunications video application. Application **105** may be any type of running application that requires display **104** for updating its display of information.

[0025] Mobile device **103** includes application screen share simulation software **115** executed from a non-transitory physical medium and running in the background. Software **115** enables dynamic simulated screen sharing for applications **105** and **106** in this example. Application **106** is running directly on top of application **105** in an application stack. In one embodiment, application **106** is executed from controls appended to application **105**. Software **115** includes a function for mitigating background transparency of application **106** so that a user may see the updated data **113** relative to application **105** through the transparent background of application **106**. In one embodiment, the function is enabled on an android platform using an android control (android: theme="@style/Theme.Transparent"). Other transparency controls may be provided for other wireless mobile computing platforms without departing from the spirit and scope of the present invention.

[0026] In a preferred embodiment, the transparency control is dynamic and self-regulating so that multiple running applications stacked using a layered approach have visible displays that are geographically brokered to allow them show through multiple transparent application backgrounds to the

physical display for user consumption. Software **115** includes a function for enabling dynamic messaging between multiple applications running on device **103** such as applications **105** and **106** in this example. There may be more than two applications stacked on device **103** all sharing display screen **104** without departing from the spirit and scope of the present invention. The inventor illustrates two such applications and deems the illustration sufficient for explanation of the present invention.

[0027] Software **115** also includes a function for assigning dominancy to one of the running applications for messaging control. In one embodiment such as assignment is by default, given to the last executed application, or the application that is running on top of the application stack. In this example, the dominant application would be application **106**. In one embodiment, application **105** is enabled with the aid of software **115** (messaging protocol) to execute application **106** and command the application to perform a task. In one example, application **105** might be a weather application and application **106** might be a telephony communications application. In such a scenario, application **105** might be enabled with the aid of software **115** (messaging protocol) to execute application **106** to run and to command application **106** to launch a video call for example. In this example, video **114** is running in a pre-selected corner of physical display **104** with the rest of the application background rendered significantly transparent.

[0028] Software **115** includes a fourth function for enabling the dominant application, in this case, application **106** to intercept digital input directed toward application **105**. The digital input might be user input applied by data input mechanism or server received digital input such as a timed data update to the application. Internet network **101** includes an Internet server **112**. Internet server **112** includes a non-transitory physical medium containing all of the software and data required to enable function as an Internet network server. Server **112** may, in this case deliver timed whether updates to application **105**. In one embodiment, those updates are intercepted by application **106** and forwarded, via the messaging mechanism, to application **105** for display in data window **113**. Software **115** mitigates the background transparency of application **106** so that updated data output **113** is visible to the user.

[0029] In one embodiment, application **105** is natively enabled to call one or more secondary applications. In another embodiment, software **115** provides the integration of this capability dynamically using the knowledge of available applications loaded on the device. In this example, the video call is launched to another user operating mobile device **109**. On device **109**, the video call occupies the full display screen. Mobile device **109** may also have software **115** installed thereon and running to provide the same functionality for that device. The messaging protocol and mechanism used by software **115** might be a proprietary mechanism or an existing mechanism with modification to enable dynamic intercept and forward of information between applications.

[0030] Any application running over top of the bottom most application is aided by software **115** in defining their display layout with window dimensions that result in a display that is smaller than the physical display and to ensure the rest of the display is sufficiently transparent via the android theme control or an equivalent if another platform is used. The application sitting at the top of the stack would get all the input from the user or from a server such as server **112**. To allow the user and or server to provide input to the other applications the top most application would intercept all such user and server events and dispatch them to the underlying applications via the proprietary messaging mechanism.

[0031] Transparency may be dynamically mitigated by each application in the stack based on collective information from all of the running applications running below the mitigating application in the stack. Moreover, applications running below the topmost application that receives user and server events may be enabled by software **115** to implement timers to ensure they continue to run, and to have their on Pause/on Resume methods (native application controls) dynamically modified to be listening for the state of running in parallel with one or more other applications. In this way, one or more applications running below the dominant application in the stack automatically display output resulting from user input or server input in a way that the user can see on the physical display.

[0032] FIG. **2** is a process flow chart **200** illustrating steps for enabling simulated screen sharing. At step **201**, a user operating a mobile device running software analogous to software **115** of FIG. **1** launches a first application (App) on the mobile device. The device may or may not be connected to an Internet server such as server **112** of FIG. **1**. Server involvement depends on the nature of the first application launched. If the application is a game application for example, the device may be connected to a game server during this process flow. However, the mobile device is not required to have an active Internet connection in order to practice the present invention.

[0033] At step **202**, the user operating the mobile device launches a second application on the mobile device. In one embodiment, the second application may be launched from controls provided to the first application. Such controls might be native controls or controls provided through an integration process enabled by the software of the present invention. At step **203**, the second application mitigates background transparency to allow a display of the first application to show through to the physical display. The software of the invention may provide knowledge of what part of the display to render transparent. Step **203** is performed dynamically while both applications are running in a preferred embodiment.

[0034] At step **204**, input control is transferred from the first application to the second or "top" application in the application stack. Assignment of this control may be made by default to the latest executed or top application in the stack. In this example the top application is the second application. In another embodiment, the user may assign dominancy to any one of multiple running applications manually. At step **205**, the second or dominant application listens for data input. Data input may comprise user input manifested through normal input mechanisms or server input sent from an Internet server or even another user operating another device or appliance connected to the network that has user permissions to control the screen of the first user.

[0035] At step **206**, the second application determines if data input was received. If it is determined that no data was received at step **206**, the process loops back until data receipt is registered. If it is determined that data was received at step **206**, it is next determined at step **207** if the data received is intended for the receiving dominant application. If it is determined at step **207** that the data received is for the dominant application, the process skips to step **210** where the input data is incorporated and displayed for output. The display area is a

non-transparent area that does not overlie the designated display area for the underlying or first application.

[0036] If it is determined at step **207** that the data received is not intended for the receiving application, the process moves to step **208** where the data is dispatched using a messaging mechanism to the first application. In the case of more than one underlying application, the dominant application determines through addressing of the message, which of the underlying applications should get the input. At step **209**, the input data dispatched by the second application is received by the first application. At step **210**, the first application incorporates the input and displays the appropriate output through the transparent background of the dominant application so the user may readily visualize the displayed information.

[0037] FIG. **3** is a block diagram illustrating dynamic screen share simulation by multiple applications. A mobile device **300** is illustrated in this example and may be analogous to device **103** of FIG. **1**. Device **300** includes a physical display that has three running applications all dynamically sharing the physical display area simultaneously. The underlying or first application on bottom of the application stack is a game application **301***a*. The second running application is application **302***a* illustrated as overlaying the first application in the stack (upper left corner of physical display). The third application is application **303***a*, which is the top most application in the stack of running applications (see upper left corner of physical display).

[0038] The top two applications mitigate transparency of their backgrounds to enable underlying applications to display updated information to the physical display so that the user may see relevant updates from all three running applications. Game application **301***a* is the bottom most application in the application stack. Game application **301***a* includes game controls **301***b* and **301***c*. Game application **301***a* includes game terrain **301***d* and call controls **301***e*. Call controls **301***e* represent a telephony integration that enables the user to launch a telephony application such as application **303***a* from within game application **301***a*.

[0039] In one embodiment, game application **301***a* is enhanced to enable a session initiation protocol (SIP) message to be sent to telephony application **303***a* to launch a video call represented by video call window **303***b*. The message includes at least minimum parameters like target SIP universal resource indicator (URI), rendered video size (left, top, width, height), and application identification (App ID), such as android package name and intended activity. In one embodiment, a desired corner of the physical display could be alternately requested for automatic video window positioning. Similarly, other messages are introduced in a preferred embodiment to provide call control features such as end call, call transfer, put on hold, call forward, and video options like video resize and video window relocation on the physical display screen.

[0040] Weather application **302***a* includes a weather update window **302***b*. In this example there are three running applications that simultaneously share the physical display of mobile device **300**. In this example, the game application is launched followed by the weather application. The weather application mitigates its background transparency to enable the user to continue game play. Weather application **302***a* mitigates the size and on-screen location of its non-transparent weather application window **302***b* so that it does not overlay game controls or features enabling the user to continue game play while checking weather updates. Weather application **302***a* might be launched separately from game application **301***a* or from within the game application. Weather application **302***a* may dynamically receive information from game application **301***a* relevant to the important parts of the game application and their locations on screen to aid it in determining its own non-transparent weather update window **302***b*, thus rendering the rest of the application background significantly transparent.

[0041] The operating user may launch telephony application **303***a* from within game application **301***a* or separately if desired. The messaging mechanism is used to enable the applications to share and incorporate information relative to application features that will show through transparent backgrounds. Therefore, telephony application **303***a* mitigates its own background transparency based on information received from all of the underlying applications, in this case game application **301***a* and weather application **302***a*. With this relevant information, telephony application arranges a non-transparent video call window **303***b* in a size and location to dynamically avoid overlying important features of the underlying applications. The result is that the operating user may play game application **301***a*, view weather updates in window **302***b*, and conduct a telephony session, in this case a video call, using controls **301***e* while viewing the called party in window **301***e*.

[0042] Each application in the application stack is running in parallel with control for updates assigned to the dominant application in the stack namely video application **303***a*. As long as telephony application **303***a* is open it may intercept user and server input intended for the game application and for the weather application. Intercepting user and server events and dispatching them to respective underlying applications for incorporation and resulting displayed output does not significantly affect application performance. The practical number of applications that may run concurrently in an application stack where background transparency is mitigated and one application receives all user and sever events for it and the other applications is dependant only upon practical physical display space available and the requirements of each application in the stack.

[0043] In one embodiment, non-transparent display areas of underlying applications may also be rendered transparent in a dynamic fashion such as when no user or server events are currently registered for that application. That is to say the entire application background for any application in the stack may be transparent until there is a registered event received that will result in an update to the display, which then may be dynamically rendered non-transparent so the window will appear to the operating user. It is noted herein that with multiple running applications sharing the physical display, call controls for executing and controlling a telephony session may be integrated with any application in the stack. In the instant example, the game application **301***a* has the highest frequency of user events and server events if the game is being played online. Therefore it is logical that the telephony controls might be integrated with the game application.

[0044] The nature of game application **301***a* suggests that user events and server events are relatively constant during game play and since the application is the bottom most application no background transparency is required. The nature of weather application **302***a* suggests that weather updates delivered by timed server updates suggests that weather window **302***b* need not be continually non-transparent. Another application with a transparent background with periodic

server updates may use the same geographic space. The applications sharing this space may alternate their non-transparent displays in the same geographic region or area of the physical display. In one embodiment, the average frequency of updates and graphics display requirements of the application may be considered in assigning application control.

[0045] In one embodiment the solution is implemented on an android platform which is Linux-based, however this should not be construed as a limitation of the present invention. Although platforms such as iOS by Apple™ currently do not provide the capability for screen sharing among multiple applications or mitigation of background transparency, modification of platform capability can be undertaken to enable the present invention to be practiced on such platforms. It should also be noted herein that application of the present invention is not limited to mobile devices or appliances.

[0046] It will be apparent to one with skill in the art that the screen-sharing simulation system of the invention may be provided using some or all of the mentioned features and components without departing from the spirit and scope of the present invention. It will also be apparent to the skilled artisan that the embodiments described above are specific examples of a single broader invention that may have greater scope than any of the singular descriptions taught. There may be many alterations made in the descriptions without departing from the spirit and scope of the present invention.

What is claimed is:

1. A system for sharing a physical display screen among multiple applications on a mobile platform, comprising:

an Internet-connected client device; and

software executing on the client device from a non-transitory physical medium, the software providing:

a first function assigning dominancy to one of the multiple running applications;

a second function mitigating application background transparency among the multiple running applications;

a third function establishing a messaging mechanism and protocol between the multiple running applications; and

a fourth function enabling the dominant application to intercept digital input directed toward individual ones of the multiple running applications and to dispatch the input to the appropriate application.

2. The system of claim **1**, wherein the mobile platform is an android platform.

3. The system of claim **1**, wherein at least one of the multiple running applications is executed by another of the multiple running applications.

4. The system of claim **1**, wherein the Internet-connected client device is an android device.

5. The system of claim **1**, wherein running application most recently executed to run is the dominant application.

6. The system of claim **1**, wherein at least one of the multiple running applications is a telephony communications application.

7. The system of claim **6**, wherein the telephony communications application enables voice and video communications.

8. The system of claim **1**, wherein assignment of dominancy to one of the multiple running applications is a default operation.

9. The system of claim **1**, wherein the digital input is user supplied or server supplied.

10. A method for sharing a physical display screen among multiple applications on a mobile platform, comprising the steps:

(a) using a layered approach, stacking the applications one over another and assigning dominancy to one of the multiple running applications;

(b) rendering the backgrounds of each application transparent;

(c) intercepting digital input intended for one of the multiple running applications at the dominant application;

(d) using a messaging protocol, sending the digital input to the intended target application from the dominant application; and

(e) mitigating the transparency of the receiving application to display the output relevant to the input received in (d).

11. The method of claim **10**, wherein the mobile platform is an android platform.

12. The method of claim **10**, wherein at least one of the multiple running applications is executed by another of the multiple running applications.

13. The method of claim **10**, wherein the Internet-connected client device is an android device.

14. The method of claim **10**, wherein at least one of the multiple running applications is a telephony communications application.

15. The method of claim **14**, wherein the telephony communications application enables voice and video communications.

16. The method of claim **14**, wherein assignment of dominancy to one of the multiple running applications is a default operation.

17. The method of claim **10**, wherein in step (c), the input includes user supplied input or input received from a server.

18. The method of claim **10**, wherein in step (b), transparency is achieved using an android style command.

19. The method of claim **10**, wherein in step (e), mitigation includes selecting the relevant application and removing at least some of the background transparency for display purposes.

20. The method of claim **10**, wherein two or more of the applications run in parallel and display updated information visible through transparent backgrounds of overlying applications.

* * * * *