Wireless-X

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Chapter 1

Main Page

Wireless-X consists of an android app backed by a python server. This app eliminates the need to buy a wireless mouse, wireless keyboard and a dedicated webcam. Using this app, the user can use his/her android smartphone's screen as mouse, a keyboard layout available on the app as the wireless keyboard, and his/her smartphone's camera as the webcam. A python server running on the target laptop/PC will capture these commands and emulate the effects on laptop.

Chapter 2

WIRELESS X

2.1 Git repository link

https://git.cse.iitb.ac.in/rajneeshkatkam/PARA-Site_WirelessX

2.2 Installation Setup

1. Make sure that you are in the Wireless-X source directory

2. Grant the permission to execute install.sh installation script using the following command:
```
$ sudo chmod a+x install.sh
```

3. Execute the install.sh script to install the necessary dependencies using the following command:
```
$ sudo ./install.sh
```

2.3 Running the application (Strictly follow the below order to run it successfully):

1. Run the Wireless-X server using the following command:
```
$ python3 Wireless-X_server.py
```

2. Enter your linux system password (the same password you enter while executing a command as "sudo"). This is

3. Application Installation and Setup on Android Smartphone:

    a. Install the Wireless-X apk on Android smartphone and give required permissions.

    b. Now, enter the IP address displayed in the terminal (on which the server is running) into the android a

    c. Click on Test Button to test the connection of smartphone with the server. If failed, Recheck if you ha

    d. After successfull connection, you would be able to control mouse, keyboard of laptop and use smartphone

    e. Now you would be able to use this virtual webcam device on chrome for video conferincing. (Tested on ch

    f. (Optional) Inorder to test if camera frames are received to the Laptop/ Desktop, use the below command
    Wireless-X apk on Android):
    ```
    $ ffplay /dev/video20
    ```

2.3.0.1 ∗Extra (Inorder to remove v42loopback devices, use below command):

```
$ sudo modprobe -r v4l2loopback
```

2.4 Steps for Debugging (If python code doesn't run after above commands):

```
1. Check if your virtual device is created

    $ ls /dev | grep -P '^video\d+$'
    OR
    $ v4l2-ctl --list-devices    # TO List the virtual devices in detail

        Output should look somewhat like this:

            Wireless-X Camera (platform:v4l2loopback-000):
                /dev/video20

            Webcam C170: Webcam C170 (usb-0000:00:1a.0-1.2):
                /dev/video0
                /dev/video1


2. Inorder to test if virtual device is working:
    Copy the sample code from  https://github.com/jremmons/pyfakewebcam page and save it as python file and ru

        $ python3 demo.py

    If everything worked correctly, no error should be displayed and terminal should be blank.
    Now, Open another terminal and test if virtual device output is being display by entering below command:

        $ ffplay /dev/video20

    Note: ffplay
```

2.5 Working (TODO)

2.6 References

OpenCV Reference:

```
https://cmsdk.com/java/android-opencv-tcp-video-streaming.html
```

v4l2loopback References:

```
https://github.com/jremmons/pyfakewebcam
https://github.com/jremmons/pyfakewebcam/issues/5
https://github.com/umlaeute/v4l2loopback#DKMS
```

Android Reference:

```
https://stackoverflow.com/questions/23024831/android-shared-preferences-for-creating-one-time-activity-example
```

Chapter 3

Hierarchical Index

3.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 4

Class Index

4.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 5

File Index

5.1 File List

Here is a list of all documented files with brief descriptions:

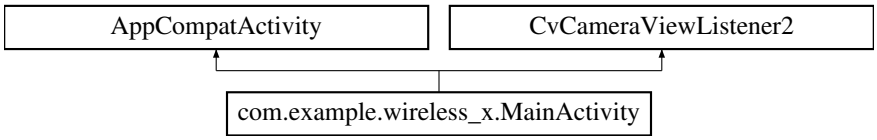
Chapter 6

Class Documentation

6.1 com.example.wireless_x.MainActivity Class Reference

This is where the main code of the Wireless-X android application is written.

Inheritance diagram for com.example.wireless_x.MainActivity:



Classes

- class **SendKeyboardPressesThread**

  Used to send the keyboard events to the server.
- class **SendMouseClicks**

  Used to send the mouse click events to the server.
- class **SendMouseCoordinatesThread**

  Sends the mouse coordinates to the server.
- class **TestIP_Thread**

  Tests whether the server's IP address is valid or not.

Public Member Functions

- void shiftPress (View view)

  Displays the keys which correspond to special characters.
- void test_IP (View view)

  Describes the action to be performed when Test IP is clicked on the app.
- String getEmojiByUnicode (int unicode)

  Returns the emoji corresponding to an unicode.
- void enter_wireless_x (View view)

  Performs the action when the "Enter Wireless-X" button is clicked.

- void onBackPressed ()

  Performs the action when the back button is pressed.
- void mouse_on_off (View view)

  Enables or disables the visibility of Mouse UI.
- void camera_on_off (View view)

  Enables or disables the camera layout.
- void camera_switch (View view)

  Implementation of the camera switch button functionality.
- void onRequestPermissionsResult (int requestCode, @NonNull String[ ] permissions, @NonNull int[ ] grant↩ Results)

  Sets up the camera view if all the permissions are granted.
- void onResume ()

  Handles the onResume state of the app.
- void onPause ()

  Handles the onPause state of the app.
- void onDestroy ()

  Handles the onDestroy state of the app.
- Mat onCameraFrame (CameraBridgeViewBase.CvCameraViewFrame inputFrame)

  Transmits the camera frames to the server.
- void layout_switch (View view)

  Sets up the layout as defined in the "activity_main.xml" file.
- void mouse_click (View view)

  Sends the mouse clicks.
- void keyPress (View view)

  Handles the key press event.

Protected Member Functions

- void onCreate (Bundle savedInstanceState)

  Sets up the app layout and contains the methods to handle various touch-related events.

6.1.1 Detailed Description

This is where the main code of the Wireless-X android application is written.

The MainActivity consists of the methods that initialize all the required variables and fields when the app starts, methods which keep listening to the mouse and keyboard events such as a mouse click event or a key press event, screen touch events, methods which send the camera frames to the virtual camera device running on the laptop and so on.

6.1.2 Member Function Documentation

6.1.2.1 camera_switch()

```
void com.example.wireless_x.MainActivity.camera_switch (
            View view )  [inline]
```

Implementation of the camera switch button functionality.

This method changes the main camera to the front or rear camera of the smartphone depending upon what the user has selected.

6.1.2.2 enter_wireless_x()

```
void com.example.wireless_x.MainActivity.enter_wireless_x (
            View view )  [inline]
```

Performs the action when the "Enter Wireless-X" button is clicked.

This method displays the mouse layout once the user clicks on "Enter Wireless-X" button.

6.1.2.3 keyPress()

```
void com.example.wireless_x.MainActivity.keyPress (
            View view )  [inline]
```

Handles the key press event.

This method handles the key press event and also handles the scroll button available on mouse layout.

6.1.2.4 onBackPressed()

```
void com.example.wireless_x.MainActivity.onBackPressed ( )  [inline]
```

Performs the action when the back button is pressed.

It checks whether the back button is pressed twice within 2 seconds, if it is, then it exits the app. It also saves the IP address of the server so that the user doesn't need to re-enter it the next time he/she opens the app.

6.1.2.5 onCameraFrame()

```
Mat com.example.wireless_x.MainActivity.onCameraFrame (
            CameraBridgeViewBase.CvCameraViewFrame inputFrame )  [inline]
```

Transmits the camera frames to the server.

On receiving a camera frame, this method encodes that frame and transmits it to the server.

6.1.2.6 onCreate()

```
void com.example.wireless_x.MainActivity.onCreate (
            Bundle savedInstanceState )  [inline], [protected]
```

Sets up the app layout and contains the methods to handle various touch-related events.

Initializes all the app components and contains an listener for those events which can occur when the user interacts with the screen by single tap, double tap, scrolling or some gesture on the screen. Method which listens for screen-touch related events.

When the user performs a double tap, it is translated to the double left-click on a physical mouse. Similarly, when the user performs a single tap, it's effect is same as a single click on any physical mouse. There is also an onScroll event which corresponds to the mouse scrolling event. This listener uses the GestureDetector class to handle such events.

Method to handle the double-tap event.

When the user performs a double tap, it is translated to the double left-click on a physical mouse. This is done by starting two threads simultaneously, which product the effect of two single-clicks without much delay, thus corresponding to a double-click.

Method to handle the single-tap event.

When the user performs a single tap, it is translated to the single left-click on a physical mouse. This is done by starting a thread, which sends the event information to the server running on laptop and then the server acts accordingly.

Method to handle the mouse scrolling event.

When the user performs a scroll event, the coordinates are transferred to the server, which translates those coordinates to the position with respect to the laptop screen.

Method to handle the screen-touch event.

This method calls the GestureDetector object to handle the screen-touch event which can be any one of the single-tap, double-tap or scroll events.

6.1.2.7 onDestroy()

```
void com.example.wireless_x.MainActivity.onDestroy ( )  [inline]
```

Handles the onDestroy state of the app.

If the app reaches the "onDestroy" state in the lifecycle, then this method disables the camera view.

6.1.2.8 onPause()

```
void com.example.wireless_x.MainActivity.onPause ( )  [inline]
```

Handles the onPause state of the app.

If the app reaches the "onPause" state in the lifecycle, then this method disables the camera view. It also saves the server's IP address so that the next time the app is opened, the user doesn't require to enter the same address again.

6.1.2.9 onRequestPermissionsResult()

```
void com.example.wireless_x.MainActivity.onRequestPermissionsResult (
            int requestCode,
            @NonNull String[] permissions,
            @NonNull int[] grantResults )  [inline]
```

Sets up the camera view if all the permissions are granted.

This method initializes all the camera parameters subject to the condition that all the required permissions are granted by the user. If this is not the case, then an error message is displayed.

6.1.2.10 onResume()

```
void com.example.wireless_x.MainActivity.onResume ( )  [inline]
```

Handles the onResume state of the app.

If the app reaches an "onResume" state in the lifecycle, then this method checks if all the permissions are granted or not, if they are, then it sets up camera parameters otherwise it requests the permissions.

6.1.2.11 shiftPress()

```
void com.example.wireless_x.MainActivity.shiftPress (
            View view )  [inline]
```

Displays the keys which correspond to special characters.

When the shift-key is pressed on the keyboard in Wireless-X app, this method changes the layout of some keys to those keys which correspond to special characters such as brackets, '@', etc.

6.1.2.12 test_IP()

```
void com.example.wireless_x.MainActivity.test_IP (
            View view )  [inline]
```

Describes the action to be performed when Test IP is clicked on the app.

This method tries to set-up a connection with the IP address entered in the textfield to check if the IP address entered by the user is valid or not.

The documentation for this class was generated from the following file:

- MainActivity.java

Chapter 7

File Documentation

7.1 MainActivity.java File Reference

This is where the main code of the Wireless-X android application is written.

Classes

- class com.example.wireless_x.MainActivity

  This is where the main code of the Wireless-X android application is written.
- class **com.example.wireless_x.MainActivity.TestIP_Thread**

  Tests whether the server's IP address is valid or not.
- class **com.example.wireless_x.MainActivity.SendMouseCoordinatesThread**

  Sends the mouse coordinates to the server.
- class **com.example.wireless_x.MainActivity.SendMouseClicks**

  Used to send the mouse click events to the server.
- class **com.example.wireless_x.MainActivity.SendKeyboardPressesThread**

  Used to send the keyboard events to the server.

7.1.1 Detailed Description

This is where the main code of the Wireless-X android application is written.

7.2 Wireless-X_server.py File Reference

This includes the code for the server-side of Wireless-X.

Functions

- def Wireless-X_server.bind_sockets ()

  This function establishes two sockets for receiving camera frames as well as mouse and keyboard actions.
- def Wireless-X_server.mouse_keyboard_connections ()

  This function decodes the received mouse and keyboard actions and acts accordingly.
- def Wireless-X_server.camera_stream_connections ()

  This function is responsible for handling the camera frames.
- def Wireless-X_server.listening_connections ()

  This function is responsible for listening to connections.

Variables

- Wireless-X_server.virtualCamera = subprocess.run(["sudo", "modprobe", "v4l2loopback", "devices=1", "video_nr=20", "card_label='Wireless-X Camera'", "exclusive_caps=1"])

  Creates a virtual camera on the laptop/PC.
- Wireless-X_server.width

  Stores the width of the screen.
- Wireless-X_server.height

  Stores the height of the screen.
- Wireless-X_server.curr_x

  Stores the x-coordinate of the current mouse location.
- Wireless-X_server.curr_y

  Stores the y-coordinate of the current mouse location.
- def Wireless-X_server.remote_x = curr_x/2

  Stores the mid of x-coordinate of current mouse location.
- def Wireless-X_server.remote_y = curr_y/2

  Stores the mid of y-coordinate of current mouse location.
- string Wireless-X_server.s = ''

  Socket used for receiving keyboard and mouse related actions.
- string Wireless-X_server.cameraSocket = ''

  Socket used for receiving the camera frames of user's smartphone.
- int Wireless-X_server.img_width = 720

  Width of the camera frame.
- int Wireless-X_server.img_height = 480

  Height of the camera frame.
- Wireless-X_server.camera = pyfakewebcam.FakeWebcam('/dev/video20', img_width, img_height)

  Virtual webcam device.
- bool Wireless-X_server.thread_run = True

  The camera and keyboard-mouse sockets receive user requests until this variable is set to 'True'.
- Wireless-X_server.keyboard = KeyboardController()

  Initializing the KeyboardController object.
- Wireless-X_server.mouse = MouseController()

  Initializing the MouseController object.
- int Wireless-X_server.mouse_speed = 2

  Speed of mouse movement.
- int Wireless-X_server.screenshot_count = 0

  Screenshot counter to keep track of screenshots.
- dictionary Wireless-X_server.special_key_android_dictionary = {"F1": "F1", "F2":"F2", "F3":"F3", "F4":"F4", "F5":"F5", "F6":"F6", "F7":"F7", "F8":"F8", "F9":"F9", "F10":"F10", "F11":"F11", "F12":"F12", "Alt":"ALT", "Backspace":"BACKSPACE", "Caps\nLock":"CAPS_LOCK", "Ctrl":"CONTROL", "Delete":"DELETE", "↓":"DOWN_ARROW", "End":"END", "Esc":"ESCAPE", "Home":"HOME", "←":"LEFT_ARROW", "META":"META", "Page Down":"PAGE_DOWN", "Page Up":"PAGE_UP", "Enter":"RETURN", "→":"RIGHT_ARROW", "Shift":"SHIFT", "Space":"SPACE", "↑":"UP_ARROW", "Tab":"Tab"}

  Maps the keys in keyboard layout to the actual keyboard keys.

7.2.1 Detailed Description

This includes the code for the server-side of Wireless-X.

The server running on laptop or PC is responsible for receiving the actions performed by user on the Wireless-X android app as well as receiving the camera frames of the user's smartphone (if the user has turned) on the camera). Such actions are transmitted to the server in encoded form, the server decodes the received message and instructs the laptop or PC to perform the action described in that message.

7.2.2 Function Documentation

7.2.2.1 bind_sockets()

```
def Wireless-X_server.bind_sockets ( )
```

This function establishes two sockets for receiving camera frames as well as mouse and keyboard actions.

```
This function creates a camera socket which is responsible for receiving the camera frames, and it also
creates another socket which is responsible for receiving the keyboard and mouse frames.
```

7.2.2.2 camera_stream_connections()

```
def Wireless-X_server.camera_stream_connections ( )
```

This function is responsible for handling the camera frames.

```
This function uses the 'OpenCV' library to decode and resize the camera frame. Then, this frame is scheduled o
the virtual webcam device created using 'pyfakewebcam' library.
```

7.2.2.3 listening_connections()

```
def Wireless-X_server.listening_connections ( )
```

This function is responsible for listening to connections.

```
This function creates two threads corresponding to the two sockets, one for handling mouse and keyboard events
and the other for handling camera frames received from the user's smartphone.
```

7.2.2.4 mouse_keyboard_connections()

```
def Wireless-X_server.mouse_keyboard_connections ( )
```

This function decodes the received mouse and keyboard actions and acts accordingly.

```
This function checks if the message received corresponds to a mouse action (left-click, scroll, etc.) or a key
(such as keypress). It then instructs the laptop to perform these actions, using the 'autopy' and 'pynput' lib
characters in keyboard are not supported by 'autopy' library, so the actions corresponding to these special ch
by the 'pynput' library, other key actions are handled by the 'autopy' library. In case of mouse, the 'autopy'
efficient, so we used the 'pynput' library.
```

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