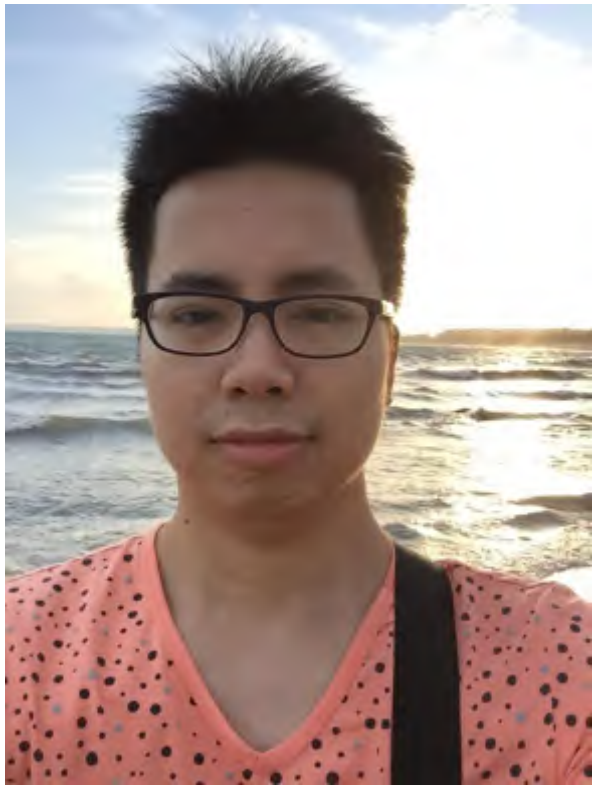
MDCC 2016
中国移动开发者大会
Mobile Developer Conference China 2016

从手Q开发谈Android无障碍化实现原理及优化

alberthe | 何金源
2016年9月



何金源 毕业于华南理工大学

手机QQ

基础Android开发组

目前负责

Android手Q无障碍化

多人聊天

基础资料卡

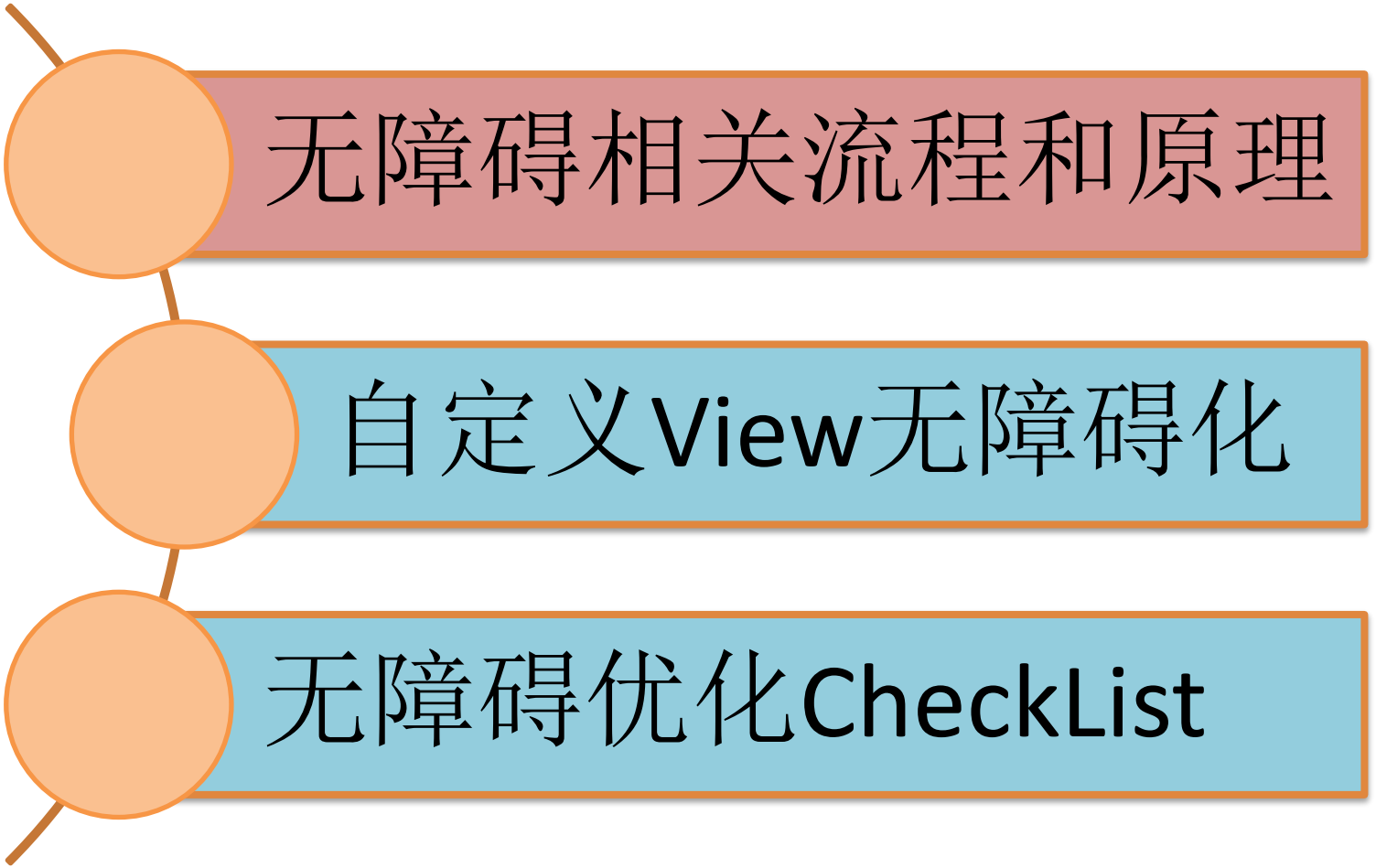

无障碍相关流程和原理
自定义View无障碍化
无障碍优化CheckList

- 无障碍化，是指针对听障、视障、肢障的用户所增加辅助项目，可以方便社会上此类有需要的人士有机会成功使用我们的应用。

- 操作方式：

选择（Hover）：单击
开启（Click）：双击
滚动：双指往上、下、左、右
选择上或下一个项目：单指往上、下、左、右
快速回到主画面：单指上滑+左滑
返回键：单指下滑+左滑
最近画面键：单指左滑+上滑
通知栏：单指右滑+下滑

- 可覆盖在任意View上
- 在屏幕上用绿色方框标明
- TalkBack根据用户交互来分配
- 表示当前活跃的元素


无障碍相关流程和原理
自定义View无障碍化
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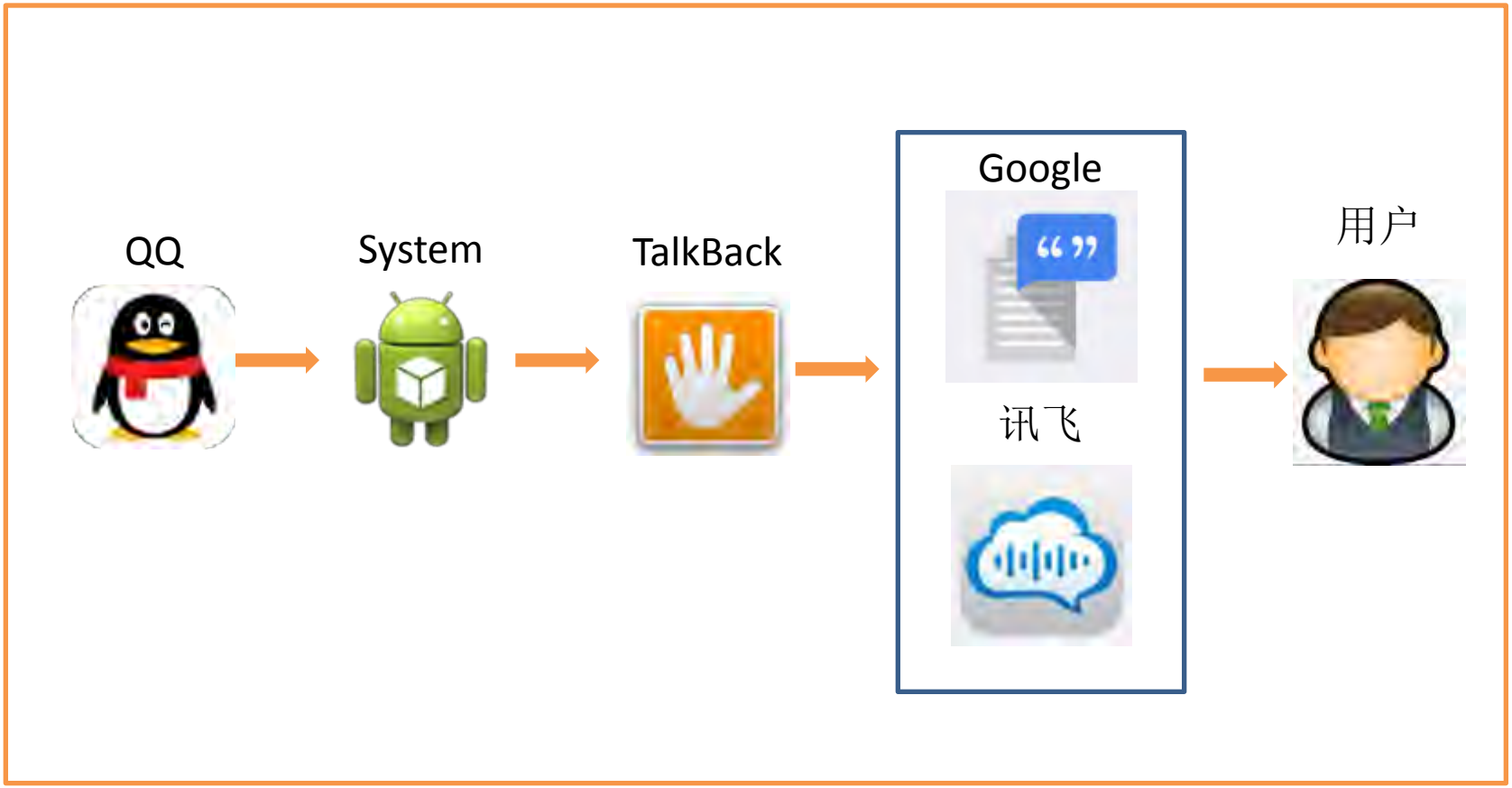
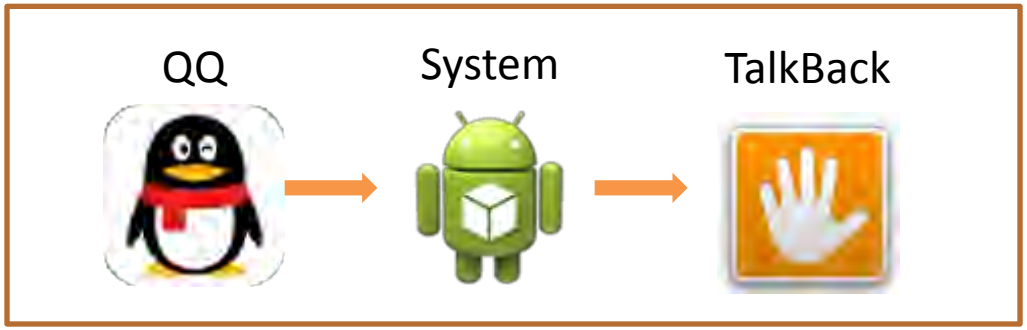
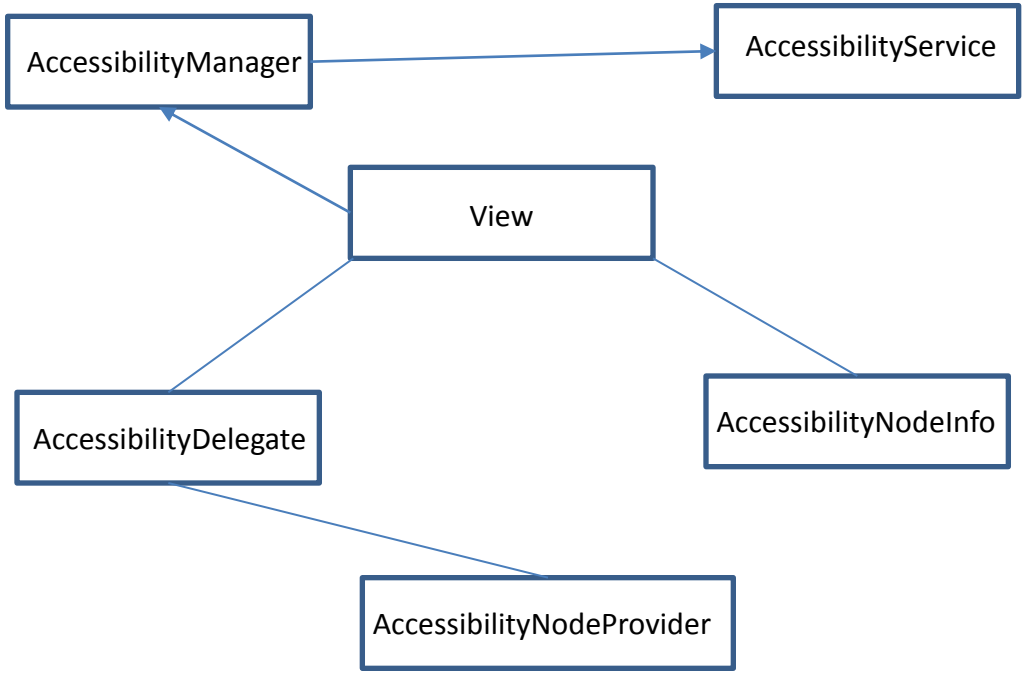
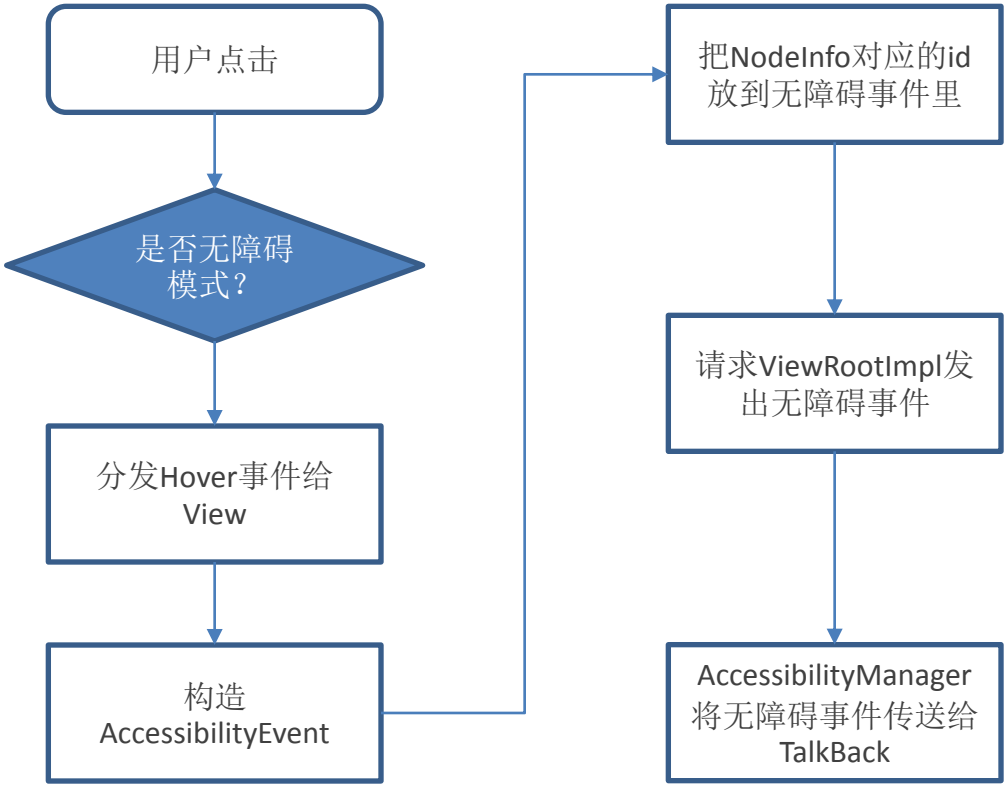

QQ
System
TalkBack
Google
讯飞
用户

无障碍相关类

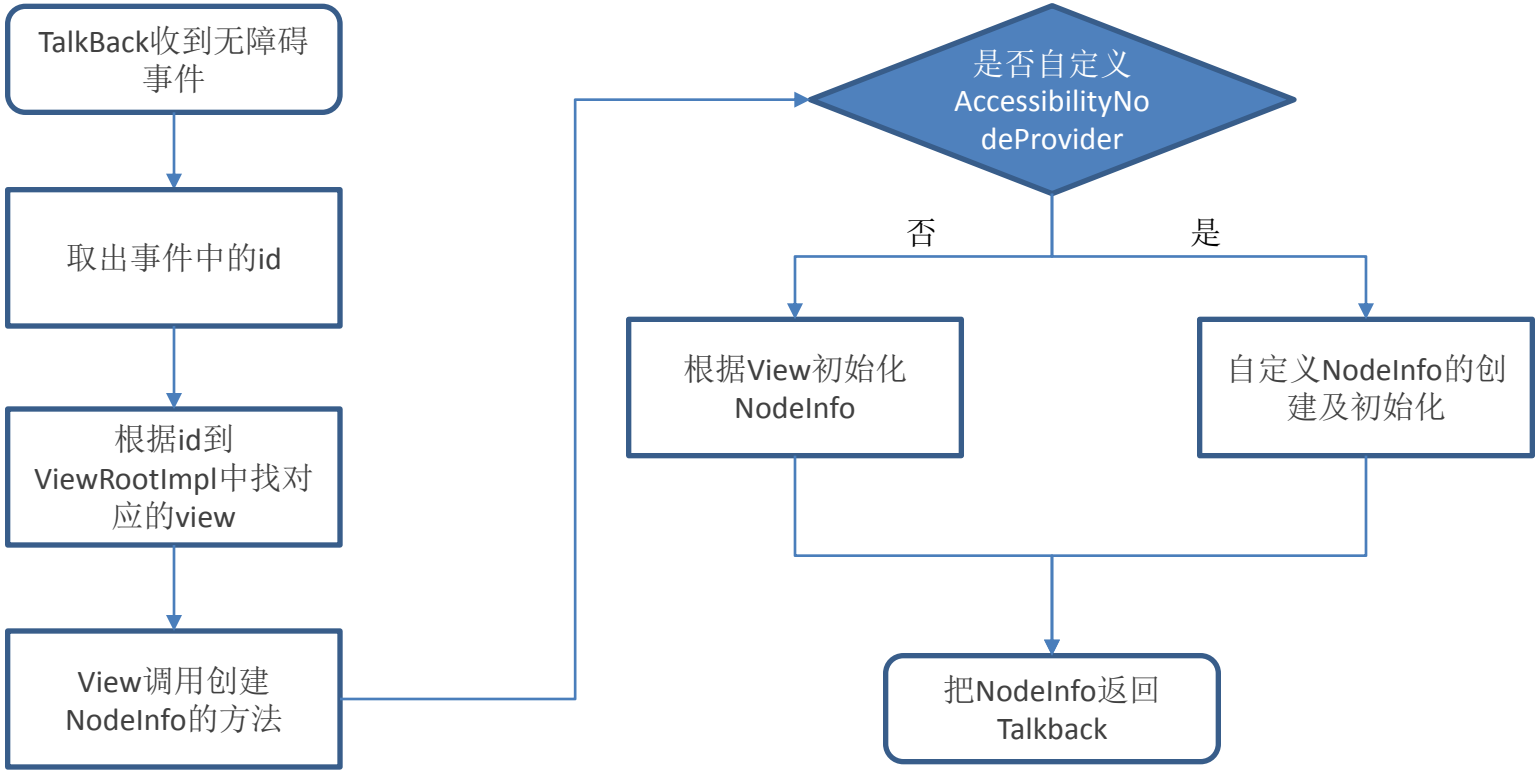

QQ
System
TalkBack

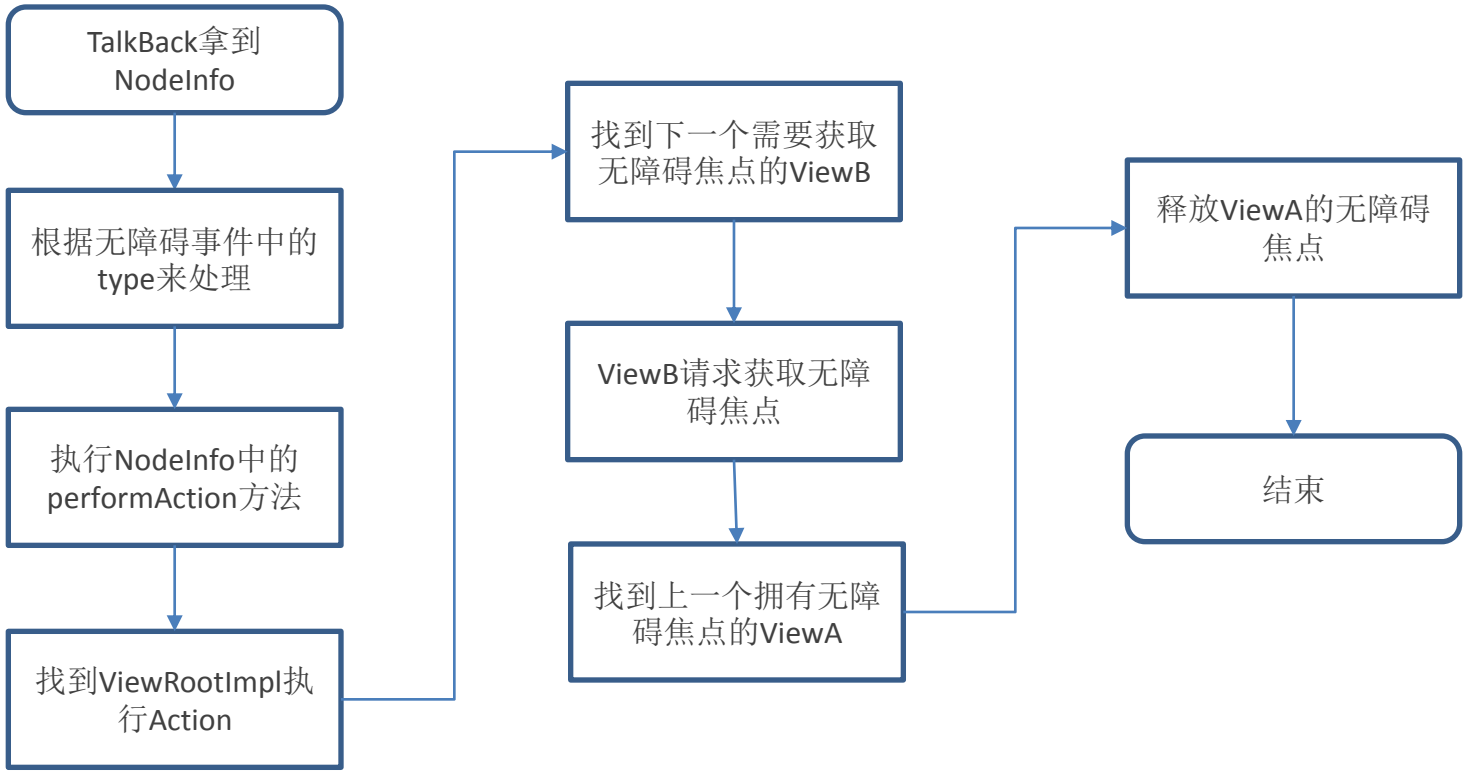

AccessibilityManager
AccessibilityService
View
AccessibilityDelegate
AccessibilityNodeInfo
AccessibilityNodeProvider

发出AccessibilityEvent

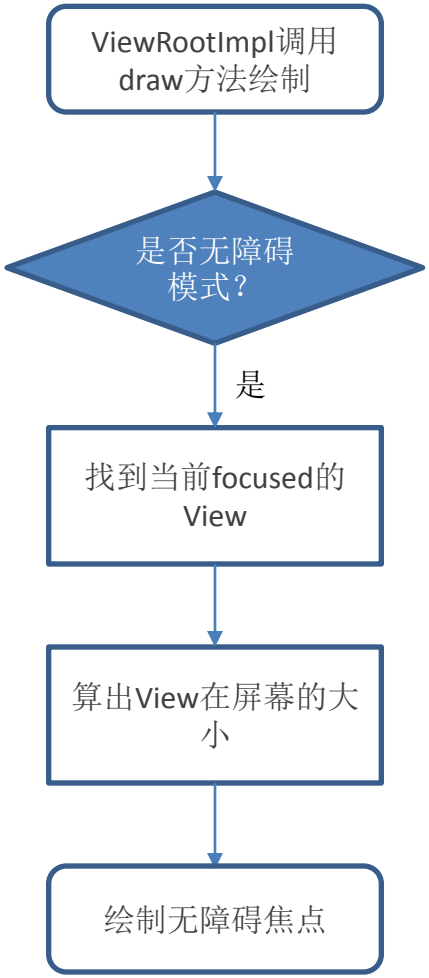


创建AccessibilityNodeInfo

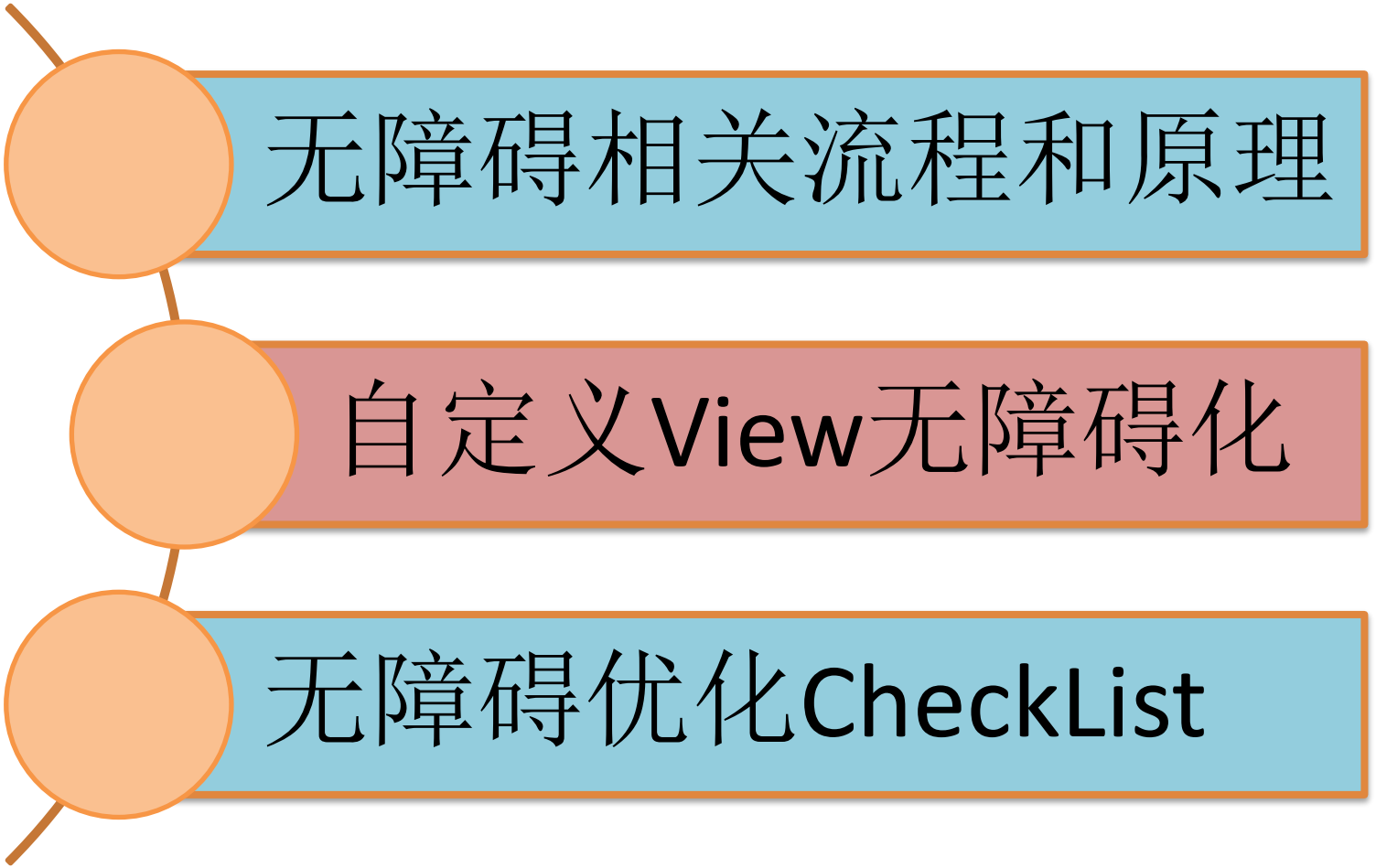



TalkBack拿到NodeInfo
根据无障碍事件中的type来处理
执行NodeInfo中的performAction方法
找到ViewRootImpl执行Action
找到下一个需要获取无障碍焦点的ViewB
ViewB请求获取无障碍焦点
找到上一个拥有无障碍焦点的ViewA
释放ViewA的无障碍焦点
结束

绘制无障碍焦点


ViewRootImpl调用draw方法绘制
是否无障碍模式？
是
找到当前focused的View
算出View在屏幕的大小
绘制无障碍焦点

- UI界面元素发生变化时（比如View被点击，View的焦点切换等），发出AccessibilityEvent
- AccessibilityService接收这些AccessibilityEvent后，根据AccessibiltyEvent里的accessibilityId来获取AccessibilityNodeInfo
- AccessibilityNodeInfo由View来创建，或者由AccessibilityNodeProvider来创建
- AccessibilityService根据AccessibilityNodeInfo的信息提供无障碍服务
- AccessibilityService通过AccessibilityNodeInfo来告知UI元素作出处理


无障碍相关流程和原理
自定义View无障碍化
无障碍优化CheckList

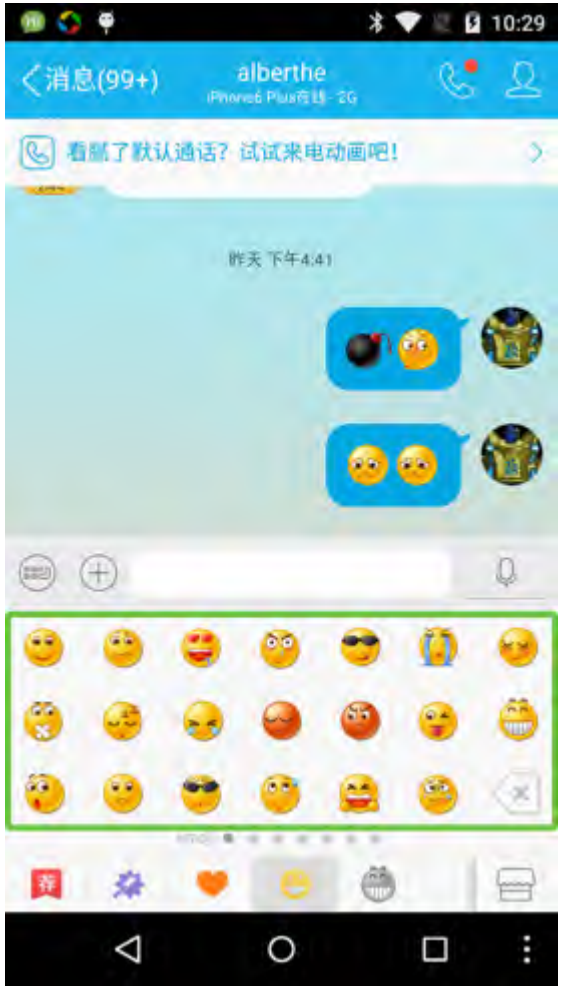
一般情况下的无障碍化

按钮添加
contentdescription

ListView的Item

会变化的元素

困难场景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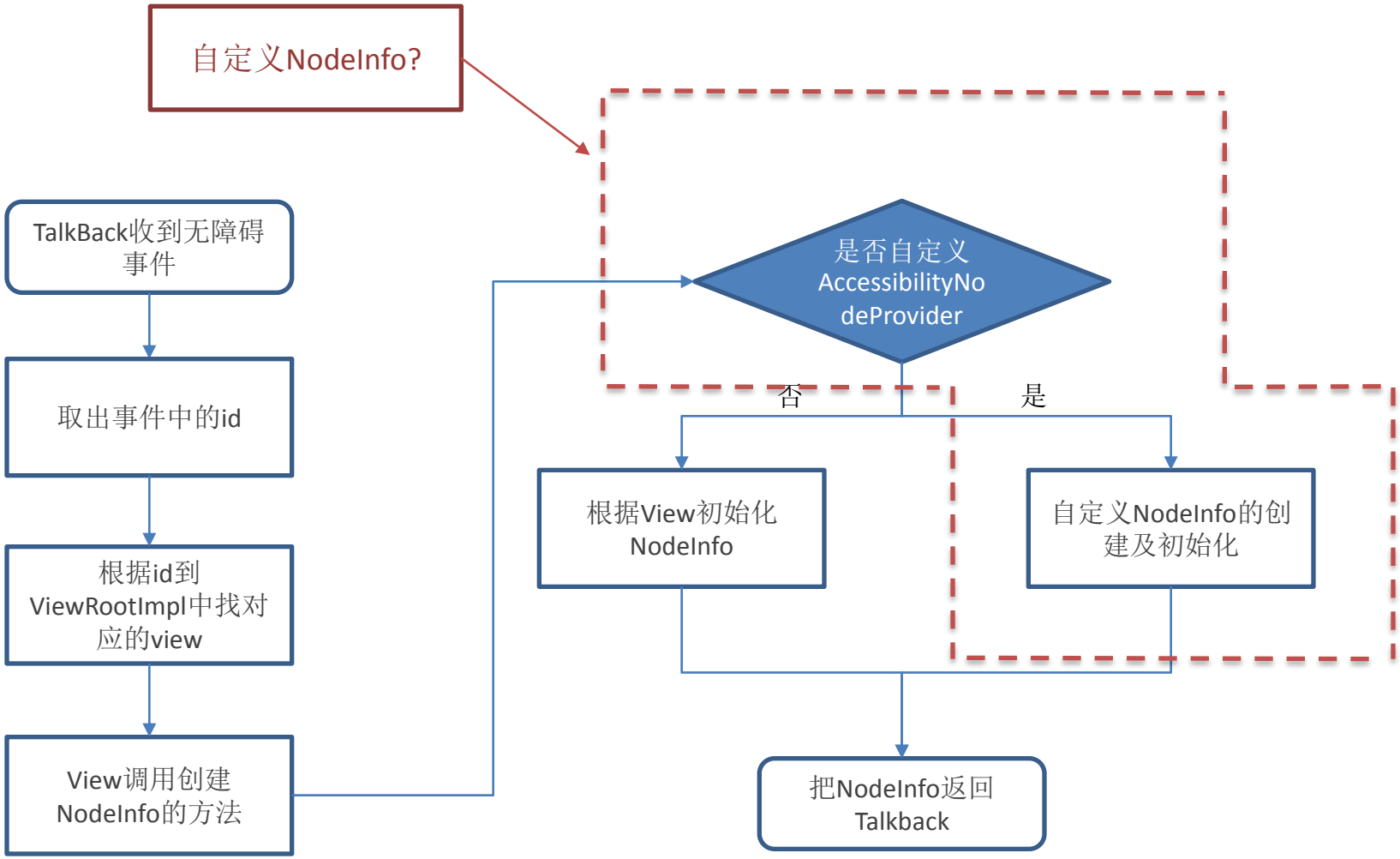
消息(99+)
alberthe
看腻了默认通话？试试来电动画吧！
昨天 下午4:41


10:25
消息(99+)
alberthe
看腻了默认通话？试试来电动画吧！
游戏设计之美-Lancelot:抢这么快啊


自定义NodeInfo?
TalkBack收到无障碍事件
取出事件中的id
根据id到ViewRootImpl中找对应的view
View调用创建NodeInfo的方法
是否自定义AccessibilityNodeProvider
否
是
根据View初始化NodeInfo
自定义NodeInfo的创建及初始化
把NodeInfo返回Talkback

- 自定义AccessibilityNodeProvider

```
public class CustomNodeProvider extends AccessibilityNodeProvider {
    @Override
    public AccessibilityNodeInfo createAccessibilityNodeInfo(
            int virtualViewId) {
        // TODO Auto-generated method stub
        return super.createAccessibilityNodeInfo(virtualViewId);
    }

    @Override
    public boolean performAction(int virtualViewId, int action,
            Bundle arguments) {
        // TODO Auto-generated method stub
        return super.performAction(virtualViewId, action, arguments);
    }
}
```

- 创建根AccessibilityNodeInfo

```
@Override
public AccessibilityNodeInfo createAccessibilityNodeInfo(int virtualViewId) {
    AccessibilityNodeInfo info = null;
    if (virtualViewId == View.NO_ID) {
        info = AccessibilityNodeInfo.obtain(CustomView.this);
        onInitializeAccessibilityNodeInfo(info);
        List<VirtualView> children = mChildren;
        final int childCount = children.size();
        for (int i = 0; i < childCount; i++) {
            VirtualView child = children.get(i);
            info.addChild(CustomView.this, child.mId);
        }
    } else {
        return createChildNodeInfo(virtualViewId);
    }
    return info;
}
```

- 创建子AccessibilityNodeInfo

添加Action

设置子节点的边框

设置状态等

```
private AccessibilityNodeInfo createChildNodeInfo(int virtualViewId) {
    AccessibilityNodeInfo info = null;
    VirtualView virtualView = findVirtualViewById(virtualViewId);
    if (virtualView == null) {
        return null;
    }
    info = AccessibilityNodeInfo.obtain();
    info.addAction(AccessibilityNodeInfo.ACTION_CLICK);
    info.addAction(AccessibilityNodeInfo.ACTION_ACCESSIBILITY_FOCUS);
    info.addAction(AccessibilityNodeInfo.ACTION_CLEAR_ACCESSIBILITY_FOCUS);

    info.setPackageName(getContext().getPackageName());
    info.setClassName(virtualView.getClass().getName());
    info.setSource(CustomView.this, virtualViewId);

    Rect mTempRect = new Rect();
    getLocalVisibleRect(mTempRect);

    info.setBoundsInParent(mTempRect);

    int[] mTempGlobalRect = new int[2];
    getLocationOnScreen(mTempGlobalRect);
    final int offsetX = mTempGlobalRect[0];
    final int offsetY = mTempGlobalRect[1];
    Rect mTempScreenRect = new Rect();
    mTempScreenRect.set(mTempRect);
    mTempScreenRect.offset(offsetX, offsetY);
    info.setBoundsInScreen(mTempScreenRect);

    info.setParent(CustomView.this);
    info.setText(virtualView.mText);
    info.setVisibleToUser(true);
    info.setAccessibilityFocused(true);
    info.setFocusable(true);
    info.setClickable(true);
    info.setEnabled(isEnabled());
    info.setContentDescription(virtualView.mText);
    return info;
}
```

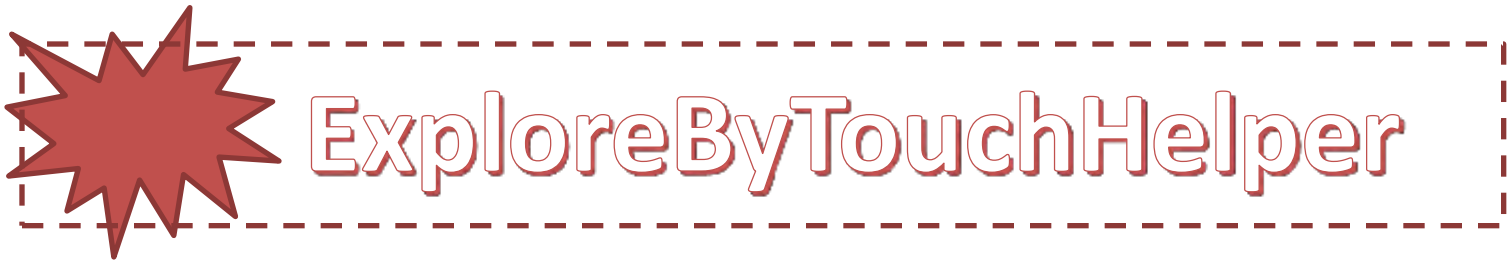
- 实现performAction方法

```
@Override
public boolean performAction(int virtualViewId, int action, Bundle arguments) {
    switch (virtualViewId) {
        case View.NO_ID:
            return performActionForHost(action, arguments);
        default:
            return performActionForChild(virtualViewId, action, arguments);
    }
}
```

创建好根节点和子节点后，AccessibilityNodeProvider会被系统调用performAction，来执行指定的无障碍操作（Action），根据virtualViewId判断由根节点还是子节点来执行。

- 分发HoverEvent到子节点，发出Hover无障碍事件

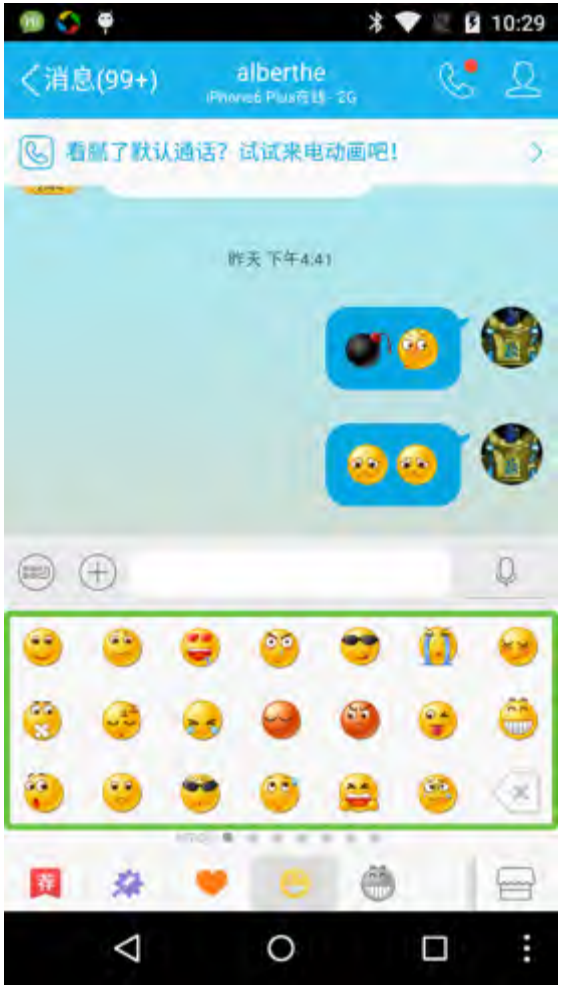
```
@Override
protected boolean dispatchHoverEvent(MotionEvent event) {
    if (!mManager.isEnabled() || !mManager.isTouchExplorationEnabled()) {
        return false;
    }
    switch (event.getAction()) {
        case MotionEvent.ACTION_HOVER_MOVE:
        case MotionEvent.ACTION_HOVER_ENTER:
            final int virtualViewId = getVirtualViewAt(event.getX(), event.getY());
            // 设置当前Hovered的子节点，发出Hover无障碍事件
            updateHoveredVirtualView(virtualViewId);
            return (virtualViewId != INVALID_ID);
        case MotionEvent.ACTION_HOVER_EXIT:
            if (mFocusedVirtualViewId != INVALID_ID) {
                updateHoveredVirtualView(INVALID_ID);
                return true;
            }
            return false;
        default:
            return false;
    }
}
```



~~AccessibilityNodeProvider~~

- 简化虚拟节点层次结构的实现
  只要实现五个抽象方法
- 隐藏AccessibilityNodeProvider的实现
- 完善控制Hover事件、无障碍事件
- 兼容性好

- 委托处理无障碍
- 标记虚拟节点ID
- 丰富无障碍信息
- 提供用户交互支持



委托ExploreByTouchHelper

```
1  private ClassicEmotionTouchHelper mTouchHelper;
2
3  public ClassicEmoticonPanelView(Context context, AttributeSet attrs) {
4      super(context, attrs);
5      ...
6
7      if(AppSetting.enableTalkBack){
8          mTouchHelper = new ClassicEmotionTouchHelper(this);
9          ViewCompat.setAccessibilityDelegate(this, mTouchHelper);
10         ViewCompat.setImportantForAccessibility(this, ViewCompat.IMPORTANT_FOR_ACCESSIBILITY_YES);
11     }
12 }
13
14 @Override
15 protected boolean dispatchHoverEvent(MotionEvent event) {
16     if(AppSetting.enableTalkBack && mTouchHelper.dispatchHoverEvent(event)){
17         return true;
18     }
19     return super.dispatchHoverEvent(event);
20 }
```

- ~~委托处理无障碍~~
- 标记虚拟节点ID
- 丰富无障碍信息
- 提供用户交互支持

- 界面上的元素使用无障碍节点id标记
- 无障碍节点id需要满足：
  - id是一个接一个的
  - id是稳定的
  - id非负整数

标记界面元素的无障碍节点id

```
private class ClassicEmotionTouchHelper extends ExploreByTouchHelper{
    ...

    @Override
    protected int getVirtualViewAt(float x, float y) {
        int index = getEmotionIndex(x,y);
        if( index >= 0){
            return index;
        }
        return ExploreByTouchHelper.INVALID_ID;
    }

    @Override
    protected void getVisibleVirtualViews(List<Integer> virtualViewIds) {
        for(int i = 0; i < mEmoticonList.size(); i++){
            virtualViewIds.add(i);
        }
        // 加上删除按钮
        virtualViewIds.add(mEmoticonList.size());
    }

    ...
}
```

- ~~委托处理无障碍~~
- ~~标记虚拟节点ID~~
- 丰富无障碍信息
- 提供用户交互支持

填充无障碍节点的属性

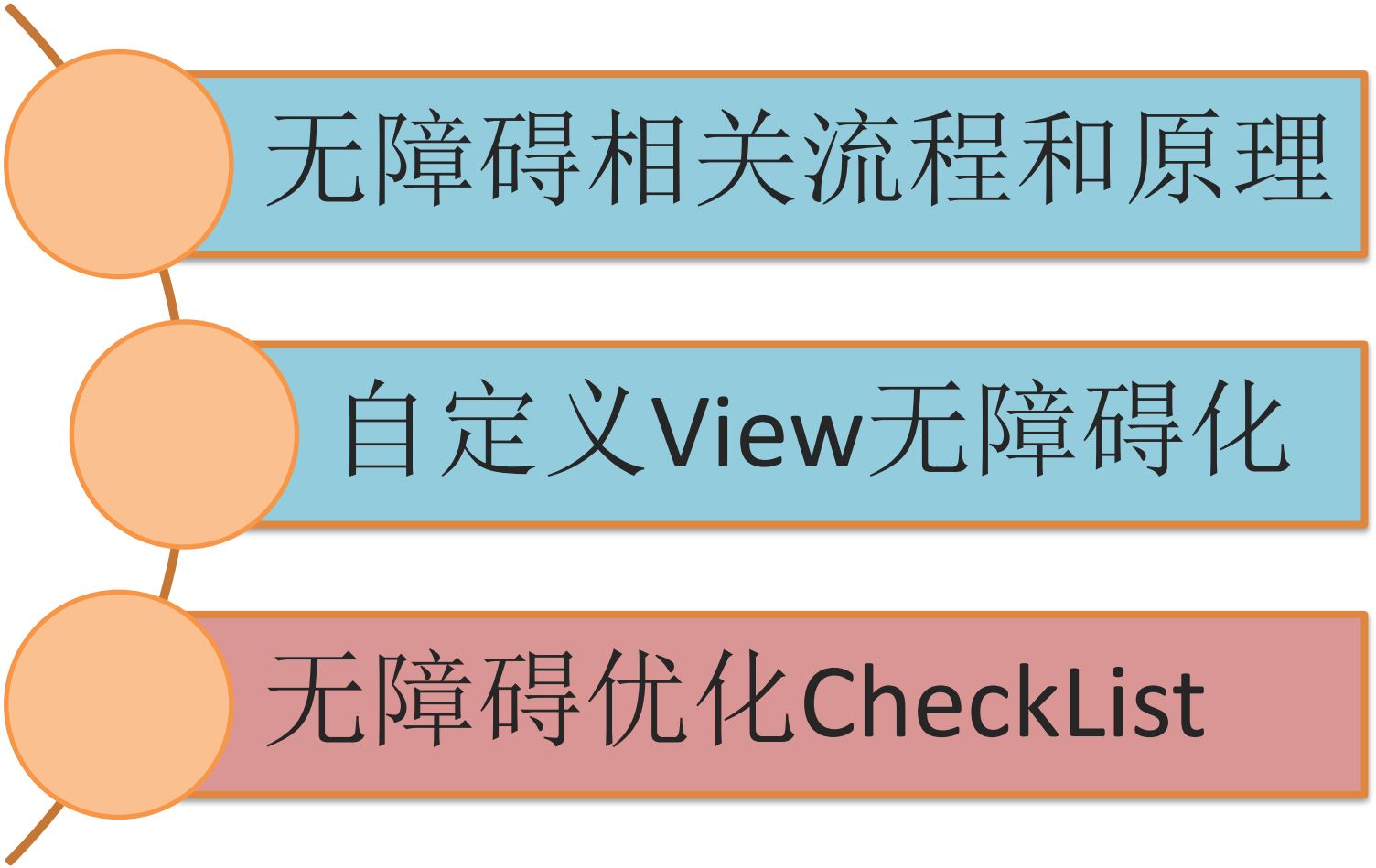
```
private class ClassicEmotionTouchHelper extends ExploreByTouchHelper{
    ...

    @Override
    protected void onPopulateEventForVirtualView(int virtualViewId, AccessibilityEvent event) {
        CharSequence desc = getDescriptionForIndex(virtualViewId);
        event.setContentDescription(desc);
    }

    @Override
    protected void onPopulateNodeForVirtualView(int virtualViewId, AccessibilityNodeInfoCompat node) {
        // 必须设置AccessibilityNodeInfo的Text或者contentDescription
        CharSequence desc = getDescriptionForIndex(virtualViewId);
        node.setContentDescription(desc);

        node.addAction(AccessibilityNodeInfoCompat.ACTION_CLICK);

        // 必须设置BoundsInParent
        Rect bounds = getBoundsForIndex(virtualViewId);
        node.setBoundsInParent(bounds);
    }

    ...
}

```

- ~~委托处理无障碍~~
- ~~标记虚拟节点ID~~
- ~~丰富无障碍信息~~
- 提供用户交互支持

提供用户交互支持

```
private class ClassicEmotionTouchHelper extends ExploreByTouchHelper{
    ...

    @Override
    protected boolean onPerformActionForVirtualView(int virtualViewId, int action, Bundle arguments) {
        switch(action){
        case AccessibilityNodeInfoCompat.ACTION_CLICK:
            onEmotionClick(virtualViewId);
            return true;
        }

        return false;
    }

    ...
}

public void onEmotionClick(int virtualViewId) {
    ...

    mTouchHelper.invalidateVirtualView(virtualViewId);
    mTouchHelper.sendEventForVirtualView(virtualViewId, AccessibilityEvent.TYPE_VIEW_CLICKED);

}
```

- ~~委托处理无障碍~~
- ~~标记虚拟节点ID~~
- ~~丰富无障碍信息~~
- ~~提供用户交互支持~~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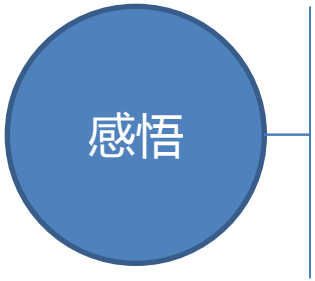
- setContentDescription
- Focusable
- Custom View
- 可变元素



1. 细节决定成败

2. 无障碍要迭代

《Android无障碍宝典》
http://geek.csdn.net/news/detail/93269

谢谢