

COMP5216 Assignment Project Exam Help

Week 03

Semester 2, 2020

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Announcements

- Change in Assignment 1 submission.

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Announcements

- 15 students still have not registered for a group.
 - Please talk to your tutor to help you find a group.
- There are 5 groups with less than 5 members.
 - Please talk to me !

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- Recall the proposal:
 - What is the problem?
 - Why does the problem matter (and significance)?
 - What is the app solution to the problem?
 - How will the solution be implemented? (so it is clear for others to implement?)
- Discuss your idea with me.
- Sometimes I ask questions, argue, ...
 - Don't agree with me always, come with evidence !
- How do I look at your idea...
 - As a teacher, As an Engineer/Developer, As an Investor

Outline

- Capabilities of modern smartphones

- Sensors
- Audio
- Connectivity
- Camera

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- Android Basics 2

- Broadcast Receiver
- Content Provider
- Services

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Capabilities of smartphones

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Smartphone capabilities



Smartphone

- **Motion** – Accelerometer, Gyroscope
 - **Vision** – Multiple Cameras
 - **Connectivity** – LTE, WiFi, Bluetooth, NFC
- Assignment Project Exam Help**
- **S**
 - **e** <https://eduassistpro.github.io/>
 - **Add WeChat** `edu_assist_pro`
 - **Haptic** – Touch-scr
 - **Biometric** – HR monitor, Iris scan, Fingerprint scan
 - **Environment** – Magnetometer, Barometer, Proximity, Ambient Temperature, Ambient Light, Humidity, Ultraviolet (UV), Moisture, Pressure

Today's Takeaway

- Smartphones are powerful.
- Allows developers to come up with innovative applications.
- How can we take advantage of capabilities of smartphones ?
 - Can you solve the challenge <https://eduassistpro.github.io/> ?
 - Can you use these capabilities to implement a solution ?
 - Can you exploit these capabilities for an innovative new app ?

Hardware vs Software

- Hardware capability/sensor
 - Physical components built into a handset
 - E.g. Accelerometer, Gyroscope, Ambient light, Pressure
- Software capability/sensor
 - Derive their data from hardware-based sensors
 - E.g. Step Count <https://eduassistpro.github.io/>
- For sensors;
 - Each sensor is accessible through the Android Sensor Framework [1]
 - Sensor availability is based on the actual handset and Android version.

[1] https://developer.android.com/guide/topics/sensors/sensors_overview

Listing sensors in a device

```
SensorManager mSensorManager =  
(SensorManager) getSystemService(Context.SENSOR_SERVICE);  
List<Sensor> deviceSensors = mSensorManager.getSensorList(Sensor.TYPE_ALL);  
  
for (Sensor temp : deviceSensors) {  
    Log.i(temp.getName(), " Sensors");  
}
```

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E.g. List of sensors

- | | | |
|-------------------------------|----------------------------------|------------------------|
| - Proximity | - Orientation | - Temperature |
| - Light | - Step detector | - Game Rotation Vector |
| - Accelerometer | - Step counter | - Tilt Detector |
| - Gyroscope | - Significant motion | - Pickup Gesture |
| - Gyroscope (uncalibrated) | - Gravity | - Sensors Sync |
| - Magnetometer | - Linear Acceleration | - Double Twist |
| - Magnetometer (uncalibrated) | - Rotation Vector | - Double Tap |
| - Pressure | - Geomagnetic Rotation
Vector | - Window Orientation |

Accelerometer

- Acceleration is the second derivative of displacement.
- One method is to get the displacement signal and calculate the second derivative.
- There are various types of accelerometers. Smartphones usually comes with (Electro-Mechanical Systems) accelerometers. <https://eduassistpro.github.io/>

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Gyroscope

- Gyroscope measures the rate of rotation in rad/s around a device's x, y, and z axis
- Provides precise device orientation than accelerometer
- Often used in co
 - er
<https://eduassistpro.github.io/>
- What can we do with Accelerometer and Gyroscopes ?
 - Camera/Photo apps

Accelerometer + Gyroscope

- One of the most used sensors
- Provides the information of device movement across all three axes.
- Determine device's orientation
 - Portrait or Landscape
 - Screen facing u
 - Games
- Activity monitoring
 - Step counting
 - Running or walking
 - Speed of running
 - Distance travelled (when GPS is not available)– How ?
- **What else can we do?**

Accelerometer + Gyroscope

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Magnetometer

- Detect magnetic fields (e.g. earth magnetic field)

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What else can we do ?

Magnetometer

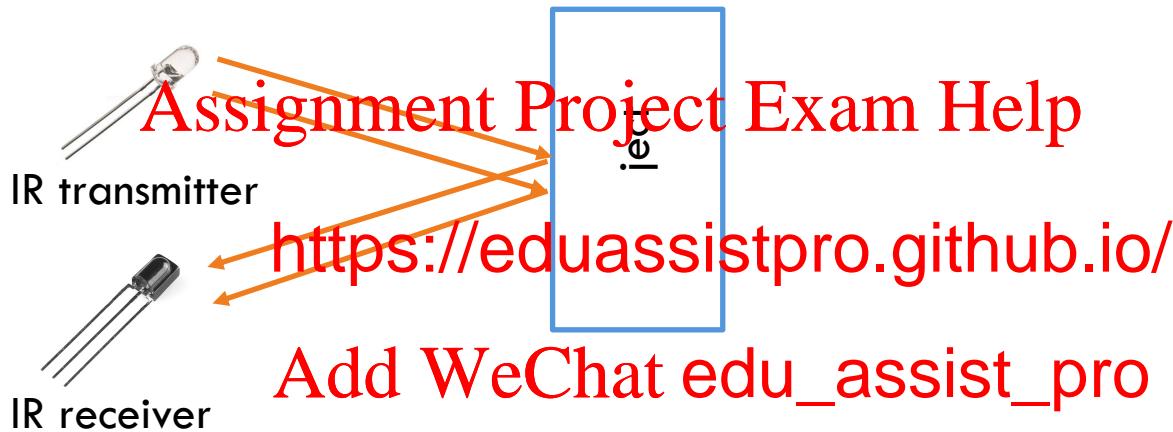
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Proximity sensor

- Infrared (IR) LED (Transmitter) and IR Receiver
- Not visible to human eye



- **What is the most common use case of proximity sensor ?**
- **What else can we do ?**

Environment sensors

- Ambient Light
 - Adjust screen brightness – Why ?
- Atmospheric pressure sensor – Barometer
 - Improve GPS accuracy
- Temperature sensor
 - Shuts device down if overheated
- Humidity sensor
 - Contributes to air quality measurements

Environment sensors

- Ambient Temperature, Ambient Light, Humidity, Ultraviolet (UV),
Moisture, Pressure
- Crowdsourced weather apps

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Haptic

- **Touchscreen** - Advanced user interaction methods
 - Multiple modes of touch
 - Multiple modes of swipe

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What else can we do ?

Haptic

- Touch patterns for user authentication
 - Alexander De Luca, Alina Hang, Frederik Brudy, Christian Lindner, and Heinrich Hussmann. 2012. Touch me once and i know it's you! implicit authentication based on touch screen patterns. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12). Association for Computing Machinery, New York, NY, USA, 987–996.
- Touch for cross-device tracking of usage
 - Masood, R., Zhao, B. Z. H., Asghar, H. J., & Kaafar, M. A. (2018). Touch and You're Trapp (ck) ed: Quantifying the Uniqueness of Touch *hancing Technologies*, 2018(2), 122-142.
<https://eduassistpro.github.io/>
- Soft biometric prediction using touch
 - Gender, age
 - Emotion
 - Miguel-Hurtado, O., Stevenage, S. V., Bevan, C., & Guest, R. (2016). Predicting sex as a soft-biometrics from device interaction swipe gestures. *Pattern Recognition Letters*, 79, 44-51.
- Touch to enable parental controlling on the phone
 - X. Li, S. Malebary, X. Qu, X. Ji, Y. Cheng, and W. Xu, "icare: Automatic and user-friendly child identification on smartphones," in Proceedings of the 19th International Workshop on Mobile Computing Systems; Applications, ser. HotMobile '18. New York, NY, USA: ACM, 2018, pp. 43–48.

Audio

- Speakers
- Microphones

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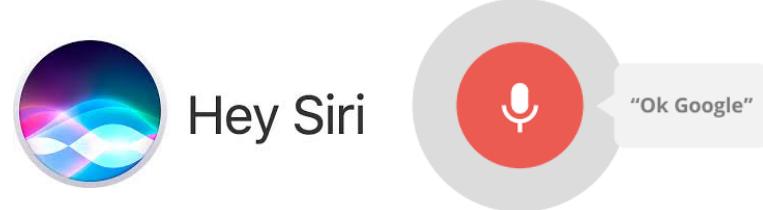
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What else can we do ?

Audio

– Voice Recognition

- Personal assistants – “Hey Siri” and “OK Google”
- Driven by the recent advances of deep machine learning



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- Ultra-sound (beyond 18kHz) based solutions
- How can we user Audio as a sensor for Advertising ?

Audio

– Acoustic motion tracking

- Wenguang Mao, Jian He, and Lili Qiu. 2016. CAT: high-precision acoustic motion tracking. In Proceedings of the 22nd Annual International Conference on Mobile Computing and Networking (MobiCom '16). ACM, New York, NY, USA, 69-81
- Wei Wang, Alex X. Liu, and Ke Sun. 2016. Device-free gesture tracking using acoustic signals. In Proceedings of the 22nd Annual International Conference on Mobile Computing and Networking (MobiCom '16). ACM, New York, NY, USA, 82-94.

– Encounter profili <https://eduassistpro.github.io/>

- Huanle Zhang, Wan Du, Pengfei Zhou, Mo Li, and Prasant Mohapatra. 2016. DopEnc: acoustic-based encounter profiling using smartphones. In Proceedings of the 22nd Annual International Conference on Mobile Computing and Networking (MobiCom '16). ACM, New York, NY, USA, 294-307.

– BreathPrint: breathing acoustic for user authentication

- Chauhan, J., Hu, Y., Seneviratne, S., Misra, A., Seneviratne, A., & Lee, Y. (2017, June). BreathPrint: Breathing acoustics-based user authentication. In Proceedings of the 15th Annual International Conference on Mobile Systems, Applications, and Services (pp. 278-291). ACM.

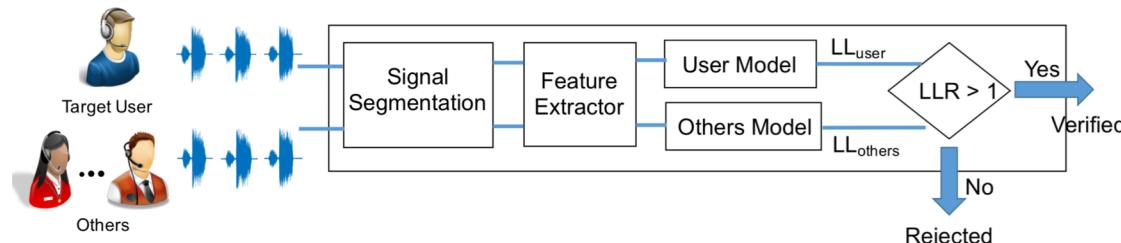


Figure 5: *BreathPrint*: System Architecture

Biometric sensors

- **Fingerprint** and **Iris** scanning for authentication

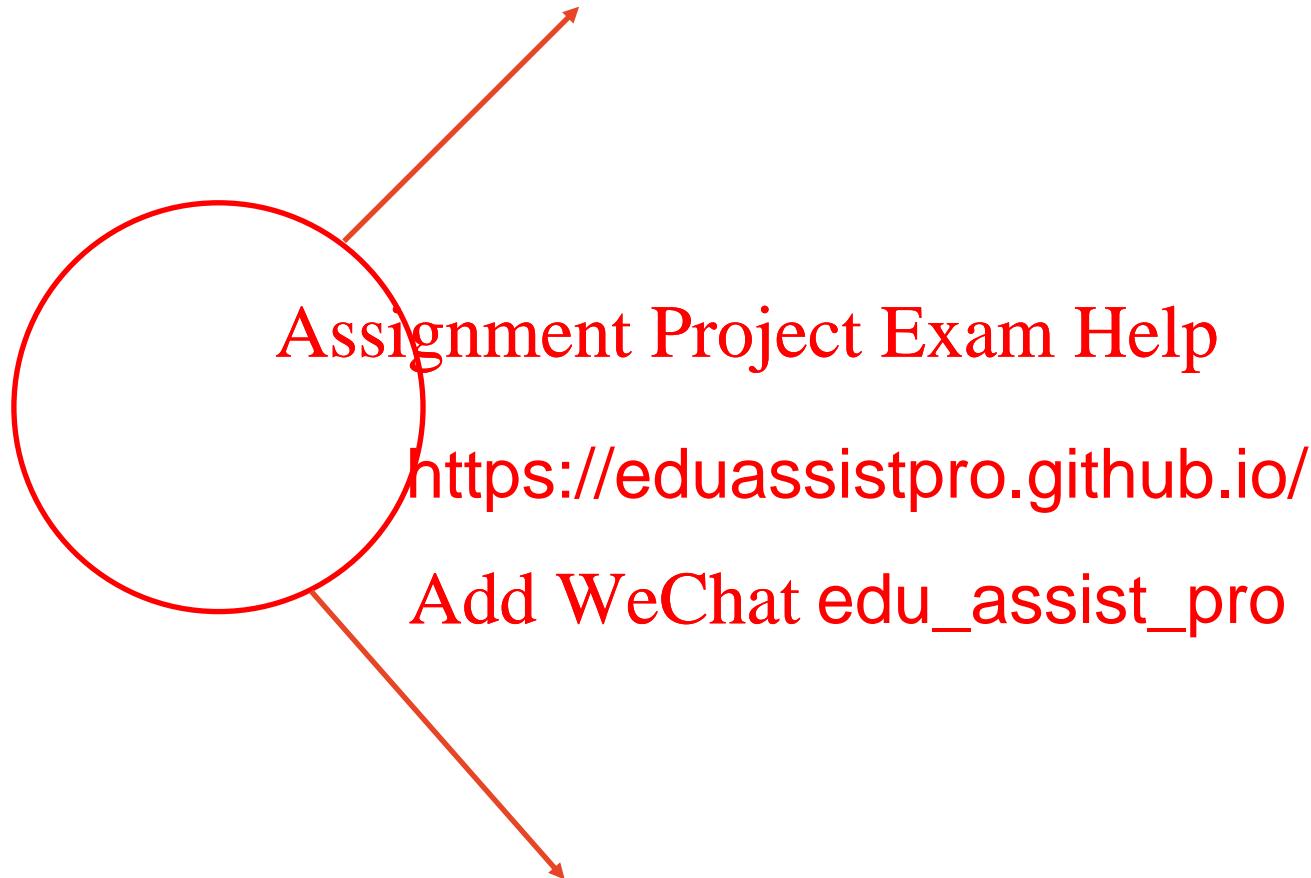
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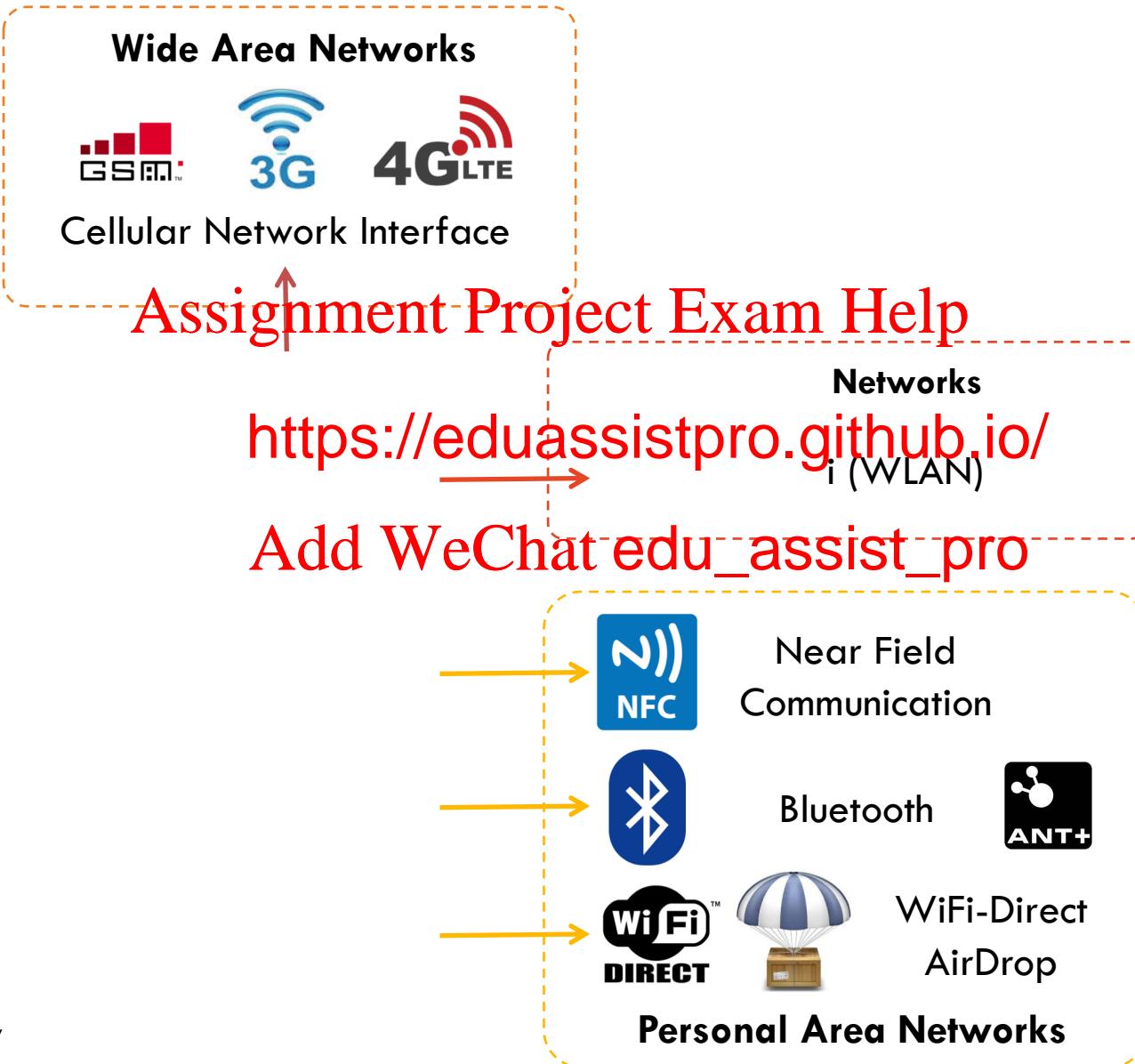
- Samsung Galaxy S9 comes with a heart rate, blood oxygen level sensor
 - Another IR base sensor
 - Measure the characteristics of the received signal

External Sensors



Seneviratne, S., Hu, Y., Nguyen, T., Lan, G., Khalifa, S., Thilakarathna, K., ...&Seneviratne, A. (2017). A survey of wearable devices and challenges. *IEEE Communications Surveys & Tutorials*, 19(4), 2573-2620.

Connectivity



Connectivity

- Connectivity empowers smartphones to control variety of smart devices



- New services thru <https://eduassistpro.github.io/>

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Card-less Payment

Location based services through iBeacons

- Advertising, Indoor navigation, ...

Connectivity

- Secure key-generation with wireless signal characteristics
 - Zhang, J., Duong, T. Q., Marshall, A., & Woods, R. (2016). Key generation from wireless channels: A review. *IEEE Access*, 4, 614-626.
- Gesture recognition with wireless signals
 - ~~<http://wittrack.c>~~ <https://eduassistpro.github.io/>
- Non-invasive Breathing disorder
 - Nandakumar, R., Gollakota, S., & Watson, N. (2015, May). Contactless sleep apnea detection on smartphones. In *Proceedings of the 13th Annual International Conference on Mobile Systems, Applications, and Services* (pp. 45-57). ACM.

Today's Takeaway

- Smartphones are powerful.
- Allows developers to come up with innovative applications.
- How can we take advantage of capabilities of smartphones ?
 - Can you solve the challenge <https://eduassistpro.github.io/> ?
 - Can you use these capabilities to implement a solution ?
 - Can you exploit these capabilities for an innovative new app ?

Today's Takeaway

- How can we take advantage of capabilities of smartphones ?
- Example Question 1: (solving an specific problem)
- You have one Assignment Project Exam Help electric light and home WiFi. You want to switch-on your li to the light (or a specific location) <https://eduassistpro.github.io/> ve motion detection sensors with you. The developer provides SDK to develop third p Add WeChat edu_assist_pro electric light ow do you design a mobile app for this specific purpose ?

Camera

- 4K videos with 30fps
- Multiple cameras on one device

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What else can we do ?

Beyond photos and videos

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Beyond photos and videos

- Document scanning apps

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Beyond photos and videos

- VeinDeep – use vein patterns of your hand for authentication
- Zhong, Henry, Salil S. Kanhere, and Chun Tung Chou. "VeinDeep: Smartphone unlock using vein patterns." *Pervasive Computing and Communications (PerCom), 2017 IEEE International Conference on*. IEEE, 2017.

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Beyond photos and videos

- **Visible light communication**

- Stefan Schmid, Linard Arquint, and Thomas R. Gross. 2016. Using smartphones as continuous receivers in a visible light communication system. In Proceedings of the 3rd Workshop on Visible Light Communication Systems (VLCS '16). ACM, New York, NY, USA, 61-66.

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Beyond photos and videos

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Mobile Augmented Reality

- Many AR SDKs
 - Apple's ARKit - <https://developer.apple.com/arkit/>
 - Google's ARCore - <https://developers.google.com/ar/discover/>
 - Wikitude - <https://www.wikitude.com/>
- Assignment Project Exam Help
<https://eduassistpro.github.io/>
- Cross-platform d
 - <https://unity.com/solutions/mobile>

Mobile AR

- Common features

- Scene recognition
- Object recognition
- Tracking of objects
- Motion tracking

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Mobile Mixed Reality

- Zapbox - <http://www.zappar.com/zapbox/>
 - Mixed Reality Video - <https://youtu.be/RnnZ3YQD4ig>
- Google Cardboard - <https://vr.google.com/cardboard/>
 - Google AR&VR Project
- Structure sensor [re.io/structure-sensor/](https://eduassistpro.github.io/re.io/structure-sensor/)
<https://eduassistpro.github.io/>

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Today's Takeaway

- How can we take advantage of capabilities of smartphones ?
- Example Question 2: (open-ended)
- You started a new company to sell small electronic items online.
Smartphones can be used to enhance the efficiency of every aspect of our business? https://eduassistpro.github.io/Add_WeChat_edu_assist_pro

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Build <https://eduassistpro.github.io/>

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Building blocks of Android

App components

- Activities
- Broadcast Receivers
- Content Providers
- Services

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- Activating components – Intent
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Android Developer Page

- <https://developer.android.com>

Many books in the library

- Android App Development by Franceschi

<https://www.safaribooksonline.com/library/view/android-app-development/9781284092134/?ar>

Intents

- Intent is a messaging object to request an action from another app component.
- Primary use-cases:
 - To start an activity
 - To start a service
 - To deliver a broadcast
- Intent types:
 - **Explicit Intents:** Communicate with a specific application. Need to specify the exact name of the component, e.g. class name.
 - **Implicit Intents:** Communicate between applications. Requested by declaring the general action to perform, e.g. location.
- <https://developer.android.com/guide/components/intents-filters>

Building blocks of an Intent

1. Component name

- Name of the component to start
 - Must specify the name for *Explicit Intent*, e.g. class name of the new Activity.
 - Empty for *Implicit Intent*

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2. Action

- String that specifies the desired action.
 - `ACTION_DIAL` - Dial a number
 - `ACTION_EDIT` - Display data to edit
 - `ACTION_SYNC` - Synchronise device data with a server
 - `ACTION_MAIN` - Start as initial activity of the app.

Building blocks of an Intent

3. Data

- Data and type of data (MIME type) associated with the Intent
- Type of data should be related to the action
 - E.g. If the action is ACTION_DIAL, data should be the phone number.
- Formatted as <https://eduassistpro.github.io/>
 - Uri.parse
- Note: To set both URI and MIME type, `setType()`

Building blocks of an Intent

4. Category

- String containing additional information about the component
 - `CATEGORY_BROWSABLE` – To start a web browser to display data
- Specify the category with `addCategory()`

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5. Extras

- Key-value pair `https://eduassistpro.github.io/` to complete the action
- Add extra info with `putExtra()`

6. Flags

- Metadata for the intent
 - E.g. How to launch the activity, how to treat it after launching, etc.
- Can set flags using `setFlags()`

Example

- Start another activity using an Intent
- Example: Tutorial 2
 - What type of an Intent is used ?

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Example 2

- Communicate between apps.
- By declaring the general action to perform. In this case,
 - Action: **ACTION_VIEW**
 - Data: Formatted as Uniform Resource Identifier (URI object) to send Intent Data

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- What type of intent is this?
- What can go wrong with the code above code block?

Intent Filters

- Declare which Intents that your app can receive with **intent-filter** element in your **AndroidManifest.xml**
 - This is how Android pass Implicit Intents to relevant apps
 - Define **<action>**, **<data>** and **<category>**
 - E.g. Declaration **Intent with text data**
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Intent Filters

- Who had a look at the AndroidManifest.xml files of Tutorial 1?
- Were there any Intent filter?

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Intent Filters

- **ACTION_MAIN** indicates this activity is the main entry point when the user launch the app and does not expect any intent data.
- **CATEGORY_LAUNCHER** indicates that activity's icon should be placed in the sys

<https://eduassistpro.github.io/>

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Broadcast Receiver

- Things are happening all the time on an Android device.
- Many components need to know that some events have occurred.
 - New package installed.
 - Phone call received.
 - WiFi is connected <https://eduassistpro.github.io/>
 - Device is rebooted.
- Android uses a Broadcast Intent [Add WeChat edu_assist_pro](#) one about it.
- All intents can be found at `BROADCAST_ACTIONS.TXT` file in the relevant SDK
- <https://developer.android.com/guide/components/broadcasts>

Broadcast Receiver

- Broadcast Receivers register to receive events.
- Android routes the Broadcast Intents to Broadcast Receivers that have registered to receive them
- Register for Bro <https://eduassistpro.github.io/>
 - **Statically:** at `AndroidManifest` Add WeChat `edu_assist_pro`
 - Using `<receiver>` and `<intent-filter>`

```
<receiver>
    <intent-filter>
        <action android:name="android.intent.action.BOOT_COMPLETED" />
    </intent-filter>
</receiver>
```

Dynamic Registration

- At MainActivity.java
- Steps:
 - Create an Intent Filter
 - Create a ~~BroadcastReceiver~~ **Assignment Project Exam Help**
 - Register ~~Broad~~ **ceiver** `()`
 - Unregister ~~Bro~~ <https://eduassistpro.github.io/> `()`.

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- To receive many broadcasts → ?

User permission

- To protect the privacy of the user
- Permissions are categorized as *normal* and *dangerous*
- Declare permission at `AndroidManifest.xml`

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Content Provider

- Provides access to a central repository of structured data.
- Use to **securely** exchange data between applications.
- Access Content Providers through a **CursorLoader** and **ContentResolver**
- Database style
- Android content <https://eduassistpro.github.io/>
 - Contacts, Audio, Video, Images, Calendar
- For more info: <http://developer.android.com/guide/topics/providers/content-providers.html>

Content Provider

- Accessing content provider – API “CURD”
 - Create (insert)
 - Retrieve (query)
 - Update
 - Delete
 - Example: Access <https://eduassistpro.github.io/> non-standard words that user wants to

Content Provider

- Querying from another app.
- `mCursor = getContentResolver().query(`
- `Uri,` → The content URI of the words table, FROM table-name
- `projection,` → The columns to return for each row
- `selection,` → Selection criteria, WHERE col = value
- `selectionArgs,` → <https://eduassistpro.github.io/>
- `sortOrder)` → Th d rows
- Add WeChat edu_assist_pro
- Content URI have the syntax:
 - **content://authority/path/id**
 - E.g. //user_dictionary/words/5
- Remember to declare permission

Services

- Does not involve a GUI component. Runs in the **background** and suitable for long running processes.
- Example functionalities achieved through services are network communications, play music and software updates.
- Three types of services:
 - **Foreground** <https://eduassistpro.github.io/>
 - **Background**
 - **Bound** Add WeChat edu_assist_pro
- For more info:
<https://developer.android.com/guide/components/services>

Services

- **Foreground**
 - Operation is noticeable to the user and must display a Notification
 - Does not require user interaction
 - E.g. Audio playback
- **Background**
 - Runs in the background <https://eduassistpro.github.io/>
 - E.g. downloading a movie
- **Bound**
 - Offers client-server interface
 - Allows other app components to interact with the service
 - E.g. for long running services and multiple operations
 - <https://developer.android.com/guide/components/bound-services>

Service Lifecycle

- Use explicit intent when starting a Service – Why ?
 - Example: Assignment Project Exam Help
 - Design and app the screen bright maximum when charging.
- <https://eduassistpro.github.io/>
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Declaring components – AndroidManifest.xml

- Describes essential information about your app to Android OS
- Examples:
 - App package name
 - Minimum API level required by the app
 - User permission
 - Declare third party services <https://eduassistpro.github.io/>
 - Declare app's components, e.g. Activities
 - Declare component capabilities through Intent filters

```
<?xml version="1.0" encoding="utf-8"?>
<manifest ... >
    <application android:icon="@drawable/app_icon.png" ... >
        <activity android:name="com.example.project.ExampleActivity"
                  android:label="@string/example_label" ... >
            </activity>
            ...
        </application>
    </manifest>
```

<https://developer.android.com/guide/topics/manifest/manifest-intro>

What's Next ?

Tutorial 3 – Data Storage and Management

- Each app is having its own storage where it can write – **Internal Storage**
- If it wants to write to the external storage it needs request for **EXTERNAL_STORAGE** permissions a .
- More details can <https://eduassistpro.github.io/>
- <http://developer.android.com/tutorials/data-storage/files.html> Add WeChat edu_assist_pro
- Week 4: Challenges associated with mobile computing