School of Computing and Information
University of Pittsburgh

Lab Project 3
Secure Mobile Application Development
Integration of a Machine Learning Tool

Version 1.2

This lab is based on mHealth project by *Haobing Huang* and *Runhua Xu*.

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Read the following guidelines before working on the project

Lab Project Goal:

The goal of this project is to learn the basic skills for developing a secure mobile health app. This project will involve the following tasks.

- Secure the outsourced medical record
- Adopt Machine Learning Toolkit
    - Learn to use vision-based machine learning toolkit to recognize the text in the image.

General Guidelines:

For this project, you will first need to review the developer's guides for **Android**, **Google Firebase** and **Cloud Key Management Service** if you don't have the relevant background and experiences. Check the following materials:

- Documentation for app developers
  [https://developer.android.com/docs/]
- Documentation for Google Firebase
  [https://firebase.google.com/docs/]
- Documentation for Google Cloud Key Management Service
  [https://cloud.google.com/kms/docs/]
- Documentation for Text Recognition
  [https://firebase.google.com/docs/ml-kit/recognize-text]
- Documentation for Google Vision API
  [https://cloud.google.com/vision/docs/ocr]

NOTE:
Please note that we have integrated the Firebase by providing our LERSAIS's ***google-services.json*** file in the project. It may not be allowed you to manage the backend server, namely, the Firebase console. If you want to debug/test your project using your own Firebase console. Please follow the instructions provided by Firebase and replace the ***google-services.json*** file that have been provided to you in the project skeleton with your own.

Moreover, we have also integrated the Google Cloud Key Management Service and provided the ***LERSAIS-mHealth-KMS-bdd9f7acef42.json*** file in the assets folder in the skeleton. Please don't create yours.

Our LERSAIS lab has real android phones for testing in case you need. Please schedule a time slot with TA.

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Secure Outsourcing Medical Record and Location-based Access Approaches

A Healthcare Scenario [extended version]

In your lab project 1 and 2, we have the following scenario:

Suppose that a patient needs to go to different hospitals/clinics for different healthcare services/checkup/treatment. It is often tedious to fill the medical forms to provide his/her medical history information such as allergy history, family genetic history, etc. Furthermore, the staff/information systems of the hospital or health clinics/units may be not fully trustworthy to store and manage his/her medical history record.

Thus, the goal here is to design a mobile healthcare application to help a user manage the medical history record. It is a user-centric medical record management application where users have full and complete control of their healthcare data.

The medical history record in your lab project 1 is stored in cloud database in plaintext. However, the medical history record is sensitive data for patients because of privacy concerns. Thus, it is necessary to encrypt the medical history record before outsourcing it to the cloud.

Then, we have considered the medical history record usage scenario. Suppose that a patient is receiving treatment in the treatment room and he/she needs to present his/her medical history record to a group of people including attending physician, assistant physician, trainee physicians and nurses in the treating room. Thus, it is necessary to design a proximity-based data access control approaches with consideration of privacy concerns.

In your lab project 3, we have the following additional application requirements:

Suppose that a patient has received the medical treatment. Before he/she leaves the hospitals/clinic, he may get some medical advice documents/papers. It is inconvenient to take or keep such documents/papers by hand. Thus, we plan to add a *medical case* feature in the app.

Specifically, users can take a photo for each medical advice document. The app can recognize the text in the photo. It is allowed to save both the photo and recognized text in the cloud database. Users can retrieve/view the medical advices anytime anywhere. In addition, as in project 2, these medical advice data should also be kept confidential in the cloud database due to privacy concerns.

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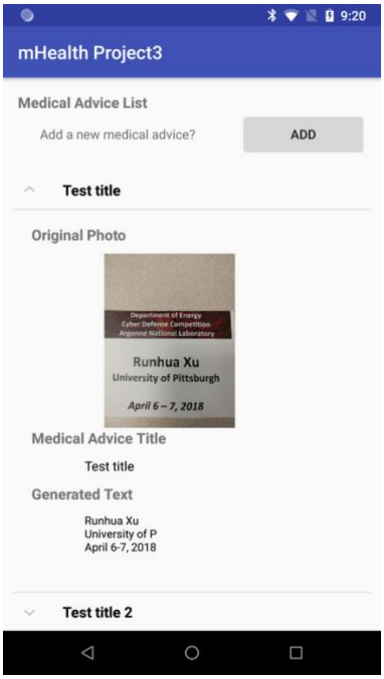
Task: Add and List Medical Advice Items

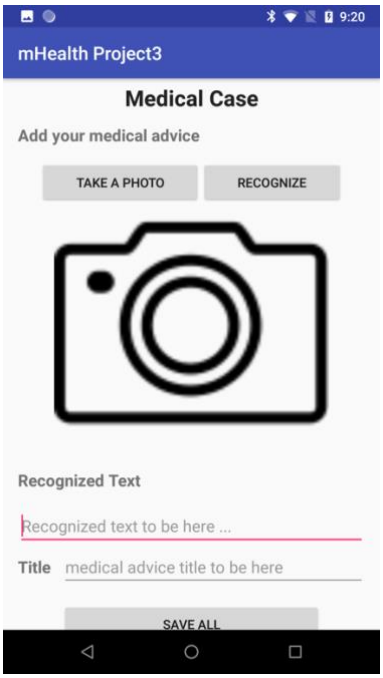
This task requires you to add a medical advice item and save the encrypted medical advice item into the cloud database. Specifically, the requirements/procedures are described as follows:

1. The medical advice should include three basic content:
    a. Title, the name of the medical advice
    b. Document Photo, the photo a user has taken for the medical advice paper
    c. Document Content, the text content recognized from the advice paper by a text recognition model.
2. The app can take a photo of the medical advice paper
3. The app can recognize the text content automatically by adopting a machine learning tool.
4. The recognized text content is editable because the machine learning model may not have 100% accuracy.
5. The app can encrypt the medical advice and save to the cloud database
6. The app can list all medical advice items that a user has.

Go through the code provided in the skeleton. The interface/view is already provided for you, so you do not need to worry about design it. We have provided the model class, namely, **MedicalAdviceRecod**, and the view/interface for adding a medical advice. Note that the photo in the model class is represented as string type due to consideration of storing all content in the database instead of storing the image file and content in Firebase Storage and Database separately. For your convenience, we also provide the **BitmapUtil** toolkit to help you encode a bitmap image into string or decode a string to a bitmap.

Sample Views





Specifically, you will accomplish the following tasks:

Task 1 Take a photo of the medical advice paper (MedicalCaseAddActivity)

Task 2 Recognize the text in the medical advice paper. (MedicalCaseAddActivity)

Note that you have more options to implement this feature, such as using text recognition service provided by Firebase, or Cloud Vision API provided by Google Cloud. Here are references:

- *https://firebase.google.com/docs/ml-kit/recognize-text*
- *https://cloud.google.com/vision/docs/ocr?authuser=2#vision-detect-labels-cli-powershell*

We don't require your text recognition has higher accuracy. One of two options is acceptable. Your self-training text recognition model is also welcome.

Task 3 Save the medical advice. (MedicalCaseAddActivity)

Note that the content outsourced to the cloud database should be encrypted. Take what you have done in project 2 as the reference.

Task 4 List all the medical advice items. (MedicalCaseListActivity)

Note that we use an ExpandableListView to present all medical advice items, which indicates a user may have more than one medical advice item. The model of MedicalAdviceRecord and the adaptor of ExpandableMedicalAdviceListAdapter have been provided. Please check the related documentation of android to learn how to use it. In addition, you can take what you have did in project 2, namely, how to present the Medical History Record as the reference. However, the difference is that a patient has only one medical history record, but have more than one medical advice records.
Here is reference for managing a list of data in Firebase:

- *https://firebase.google.com/docs/database/android/lists-of-data*