Feasibility Study of Fall Detection on A Single Personal Device

CS 5395 INDEPENDENT STUDY

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1.Introduction

According to the U.S. Center of Disease Control and Prevention, one in four Americans aged 65 and older fall each year. A recent CDC report also stated that around 28% of people aged over 65 lived alone and falls continue to be one of the leading cause of death and injury in older Americans.

Recently, there has been a lot of studies regarding the automatic fall detection using smartwatches paired with smartphones or with special purpose-built medical devices. Many fall detection systems have been experimented and implemented in the last few years using specialized sensors.

2.Project description

While smartphone and smartwatch devices are pervasive, it is difficult to keep the phone always at arm reach. For elderly people, it is especially hard to carry the phones while doing the daily chores. When they fall, it might be difficult to find the phone in order to interact with the fall detection system for the purpose of indicating that they are fine and do not really need help if the fall is not a bad one.

In this project, we demonstrate the possibility of running a fall detection system on a single personal device (i.e. smartwatch) .Smartwatches are easy to carry all the time without any hinderance and looks trendy. We also demonstrate how the data is stored on the smartwatch and how it can interact with the server.

3. The Software and platform used to implement

a. Android Studio (https://developer.android.com/studio)

b. Couchbase Lite Database (https://docs.couchbase.com/couchbase-lite/current/java-android.html)

c. Java (https://java.com/en/download/)

d. PHP (https://www.php.net/downloads.php)

e. Android Smartphone

f. Huawei Smartwatch (Watch 2)

4. Main Features and how the it works

Our main goal in this project was to demonstrate the possibility of running a fall detection system on a single personal device (i.e. smartwatch) which people can carry around all the time without any hinderance.

To achieve that, below are some of the tasks performed

a. Port the deep learning fall detection model(s) to run on a smartwatch.

b. Save the monitoring log on the watch using Couchbase Lite database.

c. Pushed the monitoring log to the server to free-up space in the watch.

Functioning of the system

1. The smartphone and the smartwatch need to be connected via Bluetooth.

2. Once they are paired , the user needs to create a user profile on the phone . Open the 'wearos' app on the watch , the watch keeps waiting for the userID to be received. (Figure 1).

3. Open the 'SmartFall' app on the phone . (Figure 2).

4. Create a profile and click on 'Save Profile'. (Figure 3).

5. Once the watch receives the userID, it shows the message as 'Received UserID' and it is ready to do the fall detection. (Figure 4).

6. The app keeps running in the background .

7.We test three scenarios as mention below .

Scenario 1:

- Once a fall is detected , a pop up appears on the watch asking if the user is ok . (Figure 5)
- If the user says 'No', then the message 'Help is on the way' pops up. (Figure 6)

Scenario 2:

- Once a fall is detected , a pop up appears on the watch asking if the user is ok . (Figure 5)
- If the user says 'Yes' , then another question is shown asking ' Did you Fall?'. (Figure 7)
- If the user says 'yes' , again 'Help is on the way 'message is shown (Figure 6)

Scenario 3:

- Once a fall is detected , a pop up appears on the watch asking if the user is ok . (Figure 5)
- If the user says 'Yes' , then another question is shown asking ' Did you Fall?'. (Figure 7)
- If the user says 'No' , there is no action and the event is captured as 'False Positive'.

8. All the data is saved on the watch using Couchbase Lite database.(Figure 8)

9. The database is connected to the server and the data from the watch is transferred to the server every 15 minutes.

Figure 1:

Figure 2:

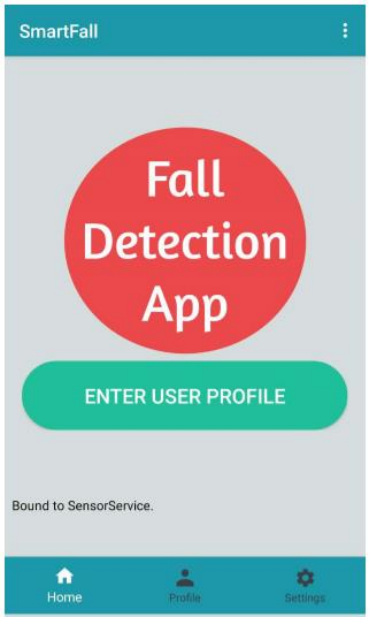


Figure 3:

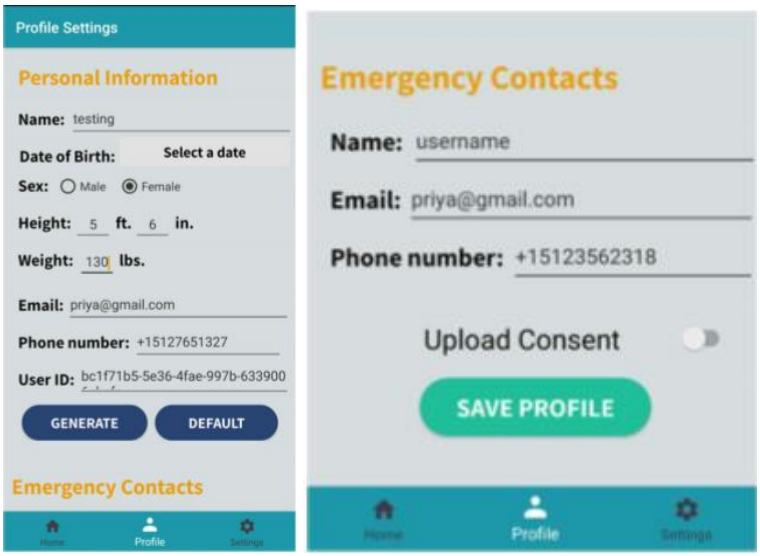


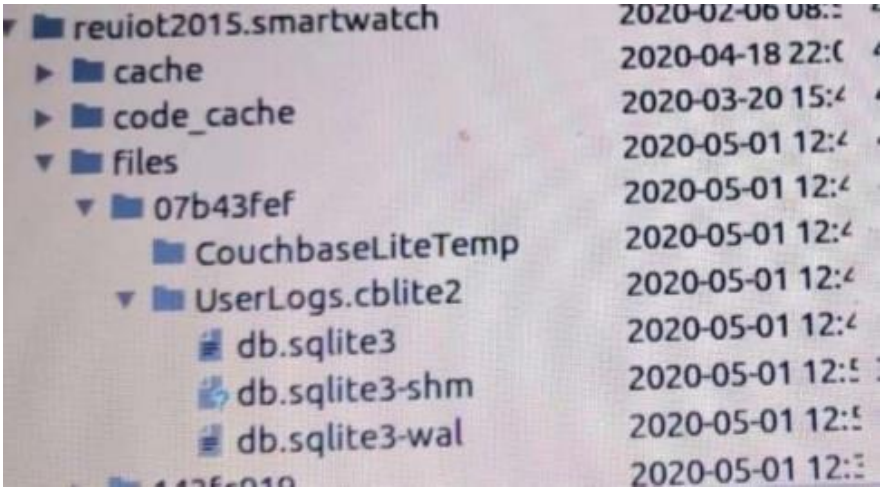
Figure 4:

Figure 5:

Figure 6:

Figure 7:

Figure 8:



5. Challenges

1.Small screen space for UI .Hence , we need the phone to update the user profile .

2.Limited free storage space remaining to save the data collected .

3.Limited battery power when in use.

4.Computation power (Qualcomm Snapdragon Wear 1.2GHz)

6.Observations

1. Watch and the phone should be paired with Bluetooth to send the userID from the phone to the watch once the user has created the profile on the phone.

2.Fall detection, other wearOS Apps, WearOS uses much of 4GB. Approximately 140MB free space to store the data.

3.The watch can run up to 5 hours when it is fully charged.

4.The watch can run up to 7 hours when the data is not uploaded to the database server.

5.Approximately 50 KB of accelerometer data is stored on the watch before the watch battery shuts down.(Used the CSV file to check how much data is being stored on the watch.)

7.Future Enhancements

1.A voice capability feature can be added on the watch .Instead of the user clicking on the button, they can record the answer via microphone.

2.Once a fall is detected and if the user needs help , an automatic message is sent to the caretaker as an alert .

8.Conclusion

In this study, we conclude that running the Fall Detection just using a single device (smart watch) is not feasible at this stage. This is because there is a dependency on the phone to update the user profile. As the UI on the watch is small, the user needs the phone to update user profile and send the userID to the watch. Once the user has updated the profile in the phone, the fall detection activities run from the phone .We do not need the phone to activate or de-activate the activate the Fall Detection App. As a future work, a voice assistant can be used to help the user to record the fall.

7.References

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[3] M. E., Metsis, V., Ngu, A., & Shaun,C "Personalized Fall Detection System "