FallAlert: A Mobile Application for Real-Time Fall Detection and Emergency Assistance

Project Presentaion for ENGG*6400 Mobile App Development

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Introduction

- The project aims to design and implement an Android application, "FallAlert," which detects falls in elderly individuals or workers in hazardous environments.

- The app provides immediate assistance by making an emergency call or sending a text message to the pre-configured contacts.

Background

- We have the experience of developing software for emergency dispatch center, understanding the requirements from different kinds of emergency situations, especially for the people who lives or works alone. It's very important to help them send out the alert automatically in case of they lose the capability to ask for help.
- As we are learning the mobile app development as well as machine learning, it motives us to do the research in this area and start developing this app. The technologies and ideas can also be used in many other wearable devices like smart watch, helmet etc.

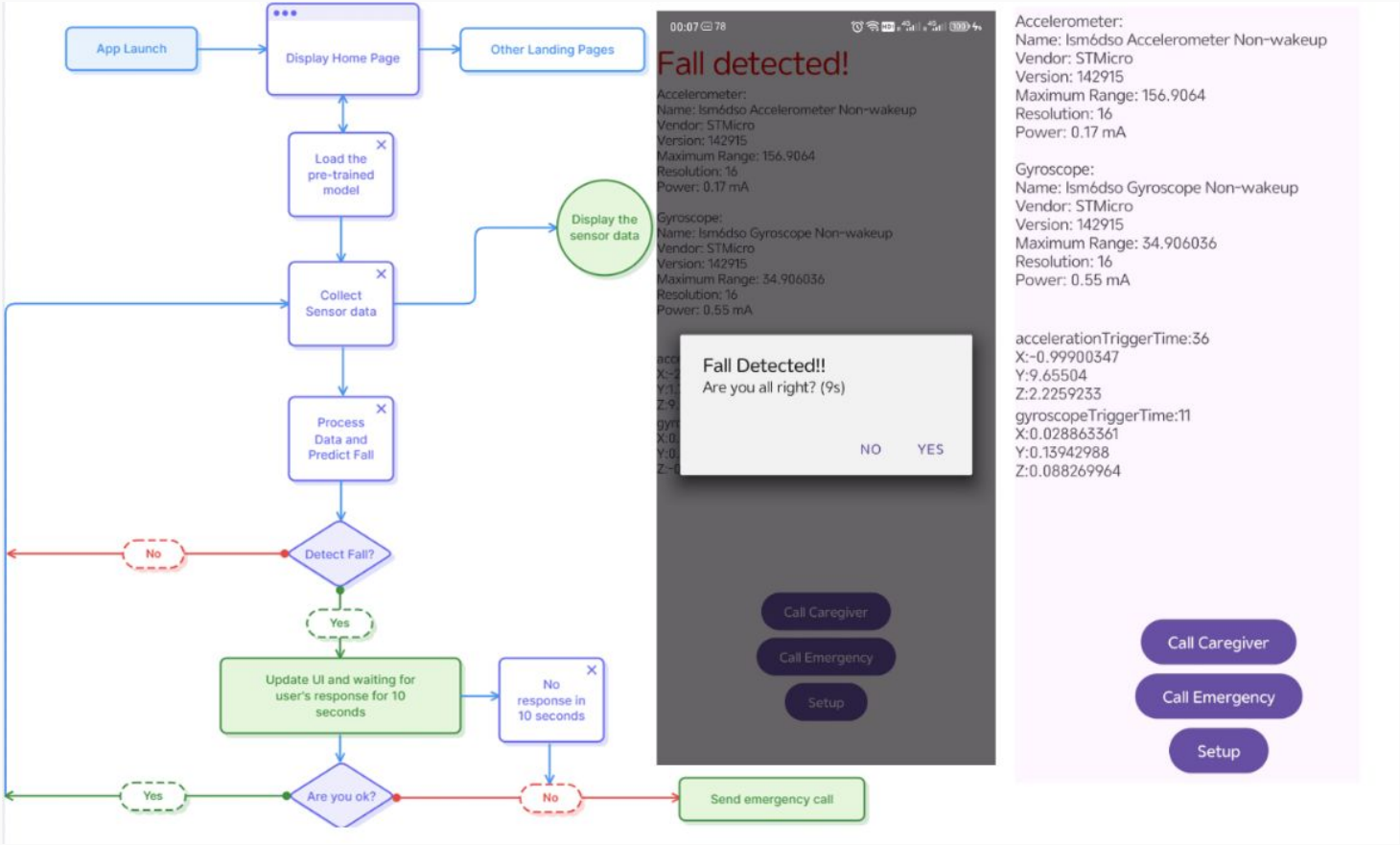
Objectives

- Fall Detection: Implement reliable fall detection algorithms in real time using smartphone sensors.
- Emergency Alert: Automatically initiate an emergency call or send a text message with the current location and fall details to emergency contacts when a fall is detected.
- User-Friendly Interface: Design an intuitive and simple user interface suitable for elderly users.
- Customizable Settings: Allow users to customize emergency contacts, SMS text message templates, and waiting time before initiating an automatic emergency call.
- Machine Learning Integration: Develop and train a machine learning model to improve the accuracy of fall detection by analyzing accelerometer and gyroscope data, reducing false positives and enhancing overall detection reliability.
- Battery saving strategy: This might be the big challenge to release the app to public user as phone manufactures will kill the app to save battery, it's hard to keep it running in the background.

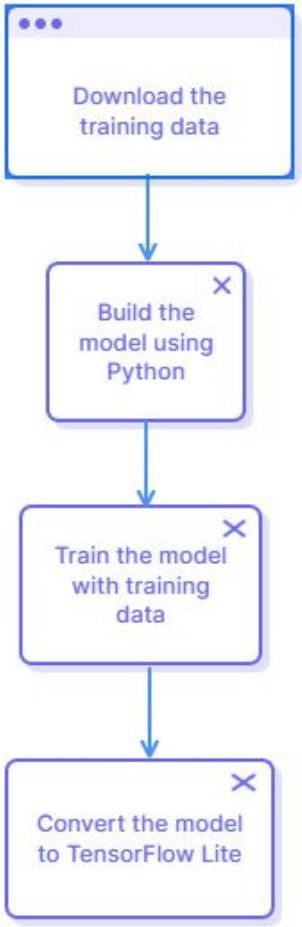
Proposed Approach

- Leverage the Android smartphone's accelerometer and gyroscope to develop an algorithm that monitors movement and detects falls.
- Create and Pre-train a tensorflow Lite model using training data from UCI Machine Learning Repository.
- Integrate the model into APP and feeding the collected sensor data to predict the fall

Block Diagram - APP



Block Diagram - Model

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396474/396474 ━━━━━━━━━━━━━━━━━━━━ 241s 607us/step - accuracy: 0.8164 - loss: 0.4192 - val_accuracy: 0.8168 - val_loss: 0.4186
Epoch 9/10
396474/396474 ━━━━━━━━━━━━━━━━━━━━ 236s 594us/step - accuracy: 0.8167 - loss: 0.4187 - val_accuracy: 0.8152 - val_loss: 0.4194
Epoch 10/10
396474/396474 ━━━━━━━━━━━━━━━━━━━━ 245s 618us/step - accuracy: 0.8169 - loss: 0.4183 - val_accuracy: 0.8172 - val_loss: 0.4163
99119/99119 ━━━━━━━━━━━━━━━━━━━━ 41s 414us/step - accuracy: 0.8177 - loss: 0.4158
Accuracy of TensorFlow model: 0.82
Saved artifact at 'fall_detection_model'. The following endpoints are available:

* Endpoint 'serve'
  args_0 (POSITIONAL_ONLY): TensorSpec(shape=(None, 6), dtype=tf.float32, name='keras_tensor')
Output Type:
  TensorSpec(shape=(None, 2), dtype=tf.float32, name=None)
Captures:
  2147532123552: TensorSpec(shape=(), dtype=tf.resource, name=None)
  2147532124608: TensorSpec(shape=(), dtype=tf.resource, name=None)
  2147532124256: TensorSpec(shape=(), dtype=tf.resource, name=None)
  2147532123376: TensorSpec(shape=(), dtype=tf.resource, name=None)
  2147532123728: TensorSpec(shape=(), dtype=tf.resource, name=None)
  2147532124960: TensorSpec(shape=(), dtype=tf.resource, name=None)
WARNING: All log messages before absl::InitializeLog() is called are written to STDERR
W0000 00:00:1718777246.147217   14988 tf_tfl_flatbuffer_helpers.cc:390] Ignored output_format.
W0000 00:00:1718777246.148000   14988 tf_tfl_flatbuffer_helpers.cc:393] Ignored drop_control_dependency.
```

Code	Activity
F01	Fall forward while walking caused by a slip
F02	Fall backward while walking caused by a slip
F03	Lateral fall while walking caused by a slip
F04	Fall forward while walking caused by a trip
F05	Fall forward while jogging caused by a trip
F06	Vertical fall while walking caused by fainting
F07	Fall while walking, with use of hands in a table to dampen fall, caused by fainting
F08	Fall forward when trying to get up
F09	Lateral fall when trying to get up
F10	Fall forward when trying to sit down
F11	Fall backward when trying to sit down
F12	Lateral fall when trying to sit down
F13	Fall forward while sitting, caused by fainting or falling asleep
F14	Fall backward while sitting, caused by fainting or falling asleep
F15	Lateral fall while sitting, caused by fainting or falling asleep

Conclusion

- "FallAlert" aims to address a critical need for safety among elderly individuals and workers in hazardous environments by leveraging mobile technology for real-time fall detection and emergency assistance.

- The project's success will rely on thorough research, user-centered design, and rigorous testing to ensure reliability and ease of use.

References

[1] K. Yildirim, G. Ucar, T. Keskin, and A. Kavak, “Fall Detection Using Smartphone-Based Application”, International Journal of Applied Mathematics Electronics and Computers, vol. 4, no. 4, 2016.

[2] Islam, M.M., Neom, N.H., Imtiaz, M.S., Nooruddin, S., Islam, M.R., Islam, M.R. (2019). A review on fall detection systems using data from smartphone sensors. Ingénierie des Systèmes d’Information, Vol. 24, No. 6, pp. 569-576. https://doi.org/10.18280/isi.240602

Thanks!