

DES 535 : Ubiquitous
Computing

SmallGuardian

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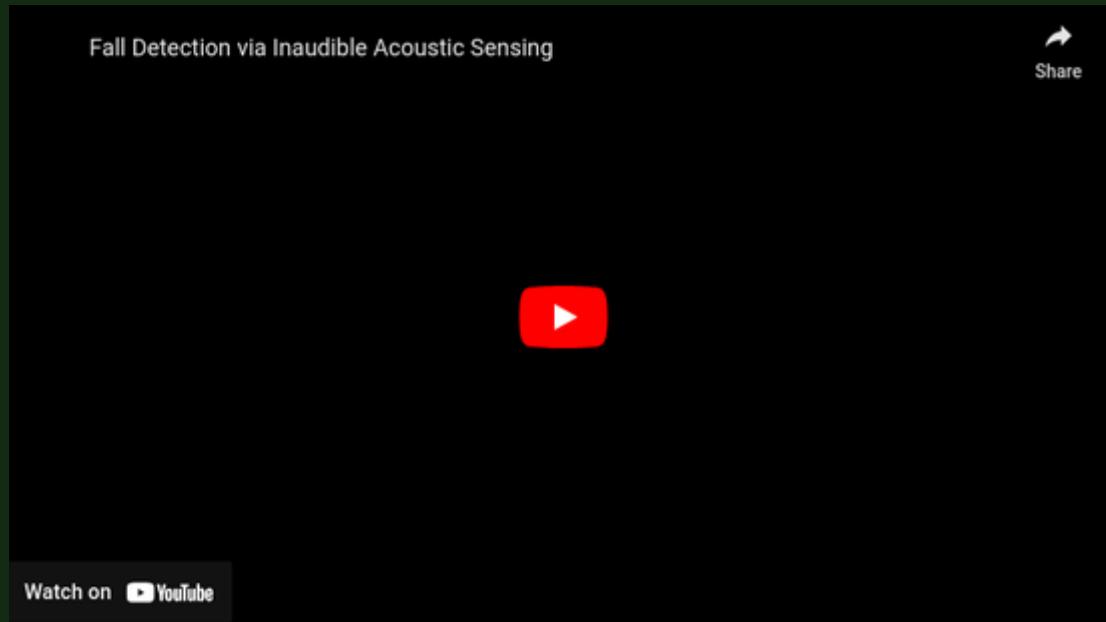
Problem Statement

Fall Detection via Inaudible Acoustic Sensing

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- Falls are a major health risk, especially for elderly individuals and people with medical conditions.
- Delayed assistance after a fall can lead to serious injuries or fatal consequences.
- Existing solutions (e.g., wearable fall detectors) are expensive and not widely adopted.

Inspiration: [Fall Detection via Inaudible Acoustic Sensing ACM SIGCHI](#)



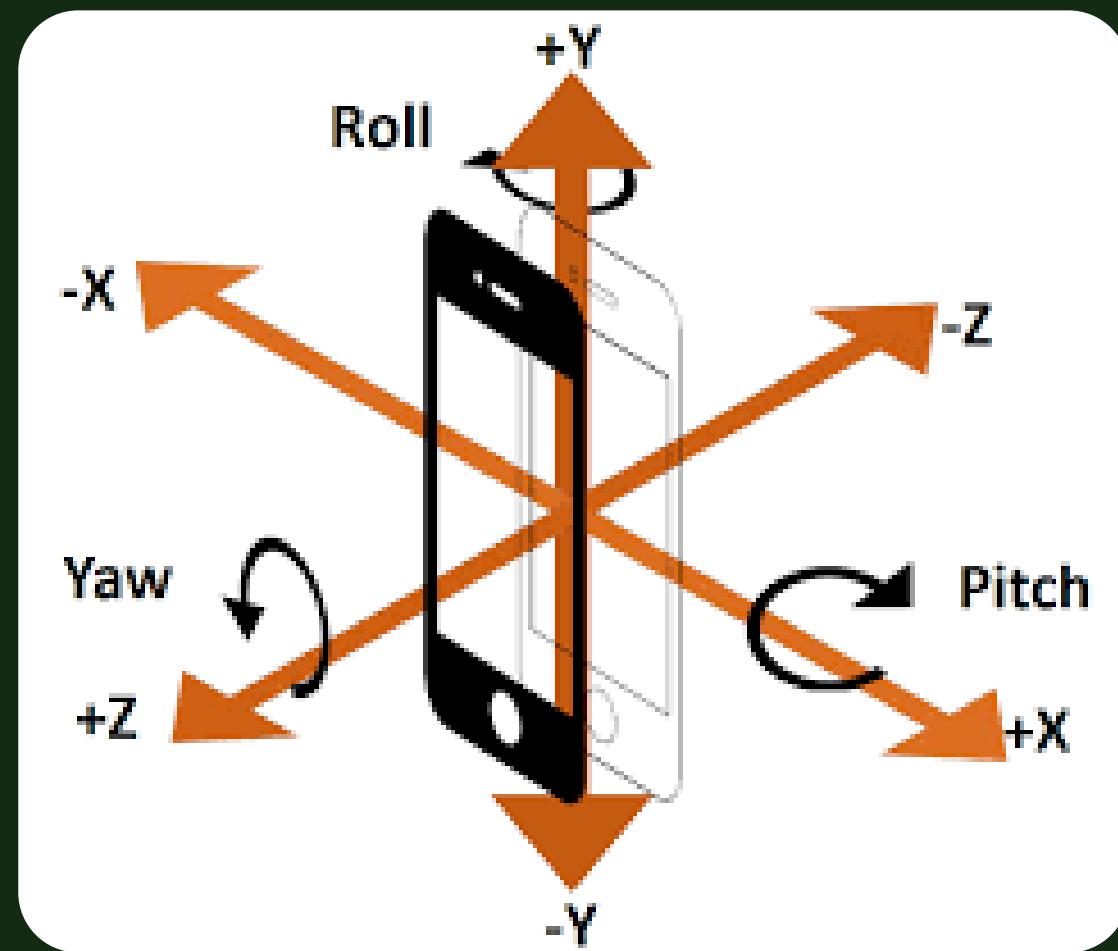
Our Product

SmallGuardian

- Smartphone-based fall detection system using built-in accelerometer and gyroscope sensors.
- Utilize Machine Learning to classify falls and distinguish them from normal activities.
- Automatically send an alert message to a predefined emergency contact in case of a fall.

🛠 Why a Smartphone App?

- ✓ Uses sensors already available in most smartphones.
- ✓ Cost-effective compared to dedicated fall detection wearables.
- ✓ No additional hardware required—only software-based implementation.



Sensors Used

Accelerometer

✓ What it does:

- Measures linear acceleration in three axes (X, Y, Z).
- Detects sudden changes in speed and movement.

✓ Why it's used for fall detection:

- Identifies free-fall motion followed by an impact.
- Differentiates between walking, running, and falling.

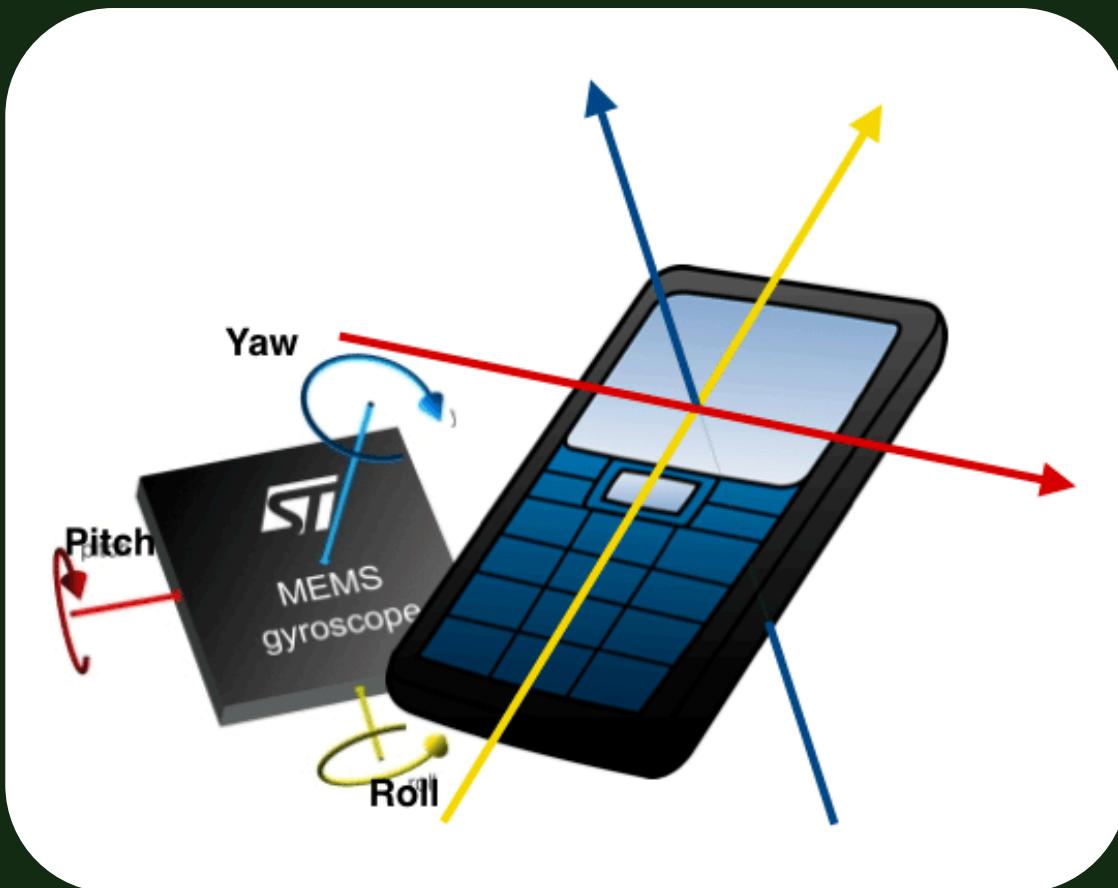
✓ Example Data:

- Normal Walking: Smooth, low variations in acceleration.
- Falling: Sudden spike in acceleration, followed by no movement.



Sensors Used

Gyroscope



✓ What it does:

- Measures angular velocity (rotation speed and direction).
- Tracks tilt, orientation, and balance changes.

✓ Why it's used for fall detection:

- Detects abnormal body tilts before and after a fall.
- Differentiates a fall from intentional movements (e.g., sitting down).

✓ Example Data:

- Standing Still: Minimal angular rotation.
- Falling: Sudden high-speed rotation before impact.

Development Data Collection



SmallGuardian (Responses) star file cloud

File Edit View Insert Format Data Tools Extensions Help

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I106 Form_Responses1

	Timestamp	accelerometer_x	accelerometer_y	accelerometer_z	gyroscope_x	gyroscope_y	gyroscope_z	label
1085	1/28/2025 23:16:11	-2.05695	3.48195	8.54295	-0.85084	6.39707	9.46168	not-fall
1086	1/28/2025 23:16:12	-1.87695	3.62805	9.276	-3.7894	1.49685	24.02054	not-fall
1087	1/28/2025 23:16:12	-1.78095	3.717	8.93595	-5.19171	-12.56568	22.54732	not-fall
1088	1/28/2025 23:16:12	0.02295	2.853	10.425	-18.63187	15.92178	4.69539	not-fall
1089	1/28/2025 23:16:12	1.52895	3.74295	9.084	-0.57511	19.07305	-1.11082	not-fall
1090	1/28/2025 23:16:12	0.79605	2.58195	8.34195	-9.53259	15.14972	8.20117	not-fall
1091	1/28/2025 23:16:13	0.10395	4.983	12.43395	18.82095	21.09774	18.56097	not-fall
1092	1/28/2025 23:16:13	0.183	2.72595	8.85	7.68909	46.51271	37.73643	not-fall
1093	1/28/2025 23:16:13	0.21195	3.79095	7.458	-14.50371	14.51947	-6.01104	not-fall
1094	1/28/2025 23:16:13	0.363	4.11705	10.13505	5.09718	8.35874	-24.98168	not-fall
1095	1/28/2025 23:16:14	0.018	3.89895	8.39895	-10.9349	10.87975	-56.76221	not-fall
1096	1/28/2025 23:16:14	0.10695	3.48195	6.69	-6.03468	13.68438	-8.67386	not-fall
1097	1/28/2025 23:16:14	-1.149	4.65795	7.296	6.70432	27.54208	63.28534	not-fall
1098	1/28/2025 23:16:14	-2.79195	3.32895	9.63705	-5.82197	69.26487	88.83424	not-fall
1099	1/28/2025 23:16:14	-3.12405	1.43805	11.079	0.7563	55.88774	127.33486	not-fall
1100	1/28/2025 23:16:14	-1.69005	1.428	10.63995	17.56044	68.56371	125.16835	not-fall
1101	1/28/2025 23:16:15	0.34605	2.64705	8.79	-2.5998	59.81107	94.64833	not-fall
1102	1/28/2025 23:16:15	-1.96995	1.749	10.52805	11.1161	59.59835	124.60902	not-fall
1103	1/28/2025 23:16:32	67.149	-24.71895	37.00905	-425.46844	-452.30145	233.6665	fall
1104	1/28/2025 23:20:19	-11.86395	-5.83995	-6.40605	-94.33321	130.817	104.18879	fall
1105	1/28/2025 23:20:26	29.904	-54.08295	24.08895	-789.9126	-321.37418	410.15326	fall
1106	1/28/2025 23:20:26	26.21895	10.689	67.85205	231.86241	220.55724	273.51428	fall
1107	1/28/2025 23:21:44	13.311	3.288	13.42005	-191.84918	-177.8024	1.99318	not-fall
1108	1/28/2025 23:22:28	3.01095	0.72405	7.84605	-7.61031	20.71171	1.07931	not-fall

+ Form Responses 1

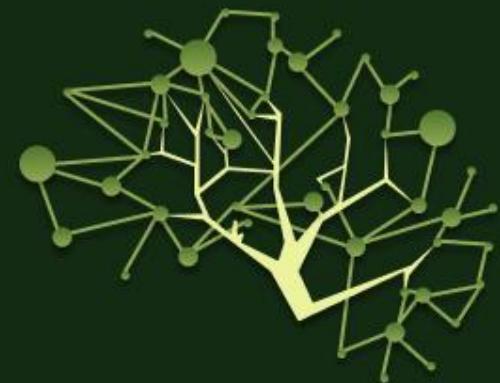
We have Collected Data from multiple activities respective to relevant domain

Labels/Classification :
not-fall
consists of Normal activities
 :
Sitting, Sleeping, Walking Hand Movements.

fall
consists of fall related activities :
Fall, Free fall (under supervised environment)

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Model Development



when SendData .Click

do

- set Label1 . Text to AccelerometerSensor1 . XAccel
- set Label2 . Text to AccelerometerSensor1 . YAccel
- set Label3 . Text to AccelerometerSensor1 . ZAccel
- set Label4 . Text to GyroscopeSensor1 . XAngularVelocity
- set Label5 . Text to GyroscopeSensor1 . YAngularVelocity
- set Label6 . Text to GyroscopeSensor1 . ZAngularVelocity

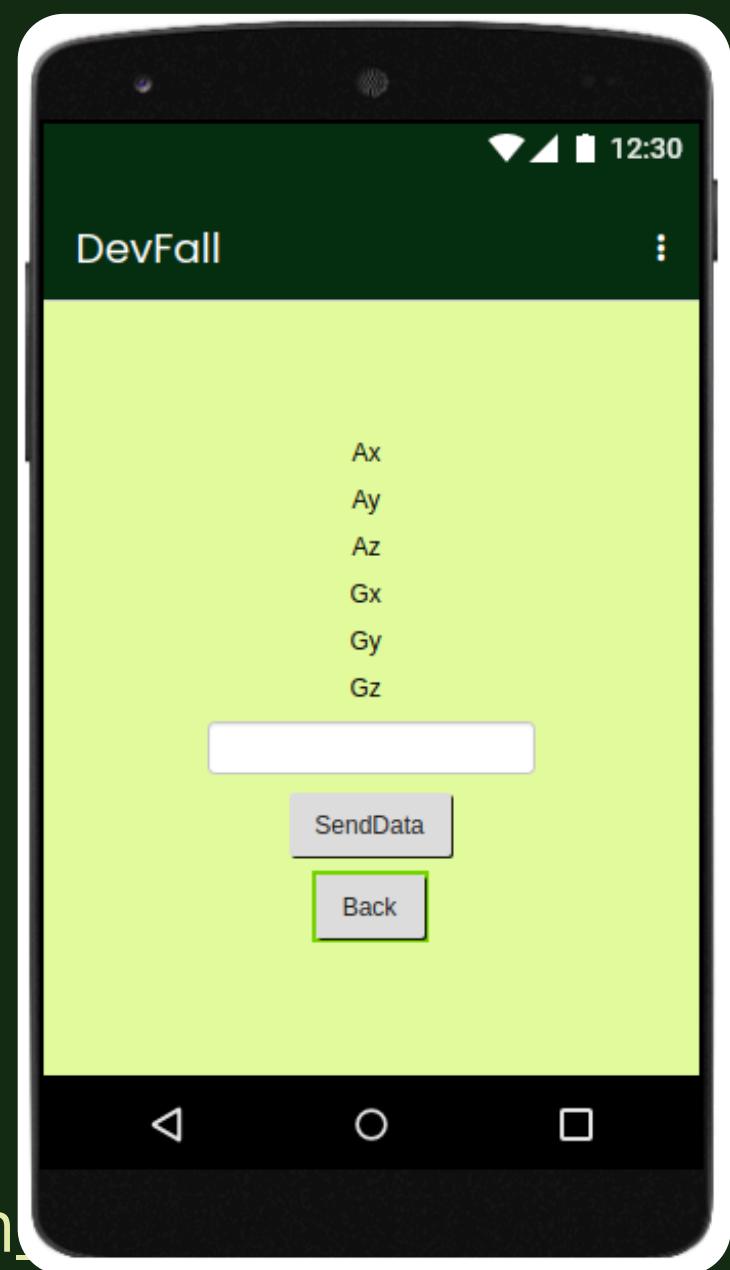
call WebViewer1 . GoToUrl

url join " https://docs.google.com/forms/d/e/1FAIpQLSfLQOkA... "

- Label1 . Text
- " &entry.434012405= "
- Label2 . Text
- " &entry.1000457194= "
- Label3 . Text
- " &entry.1644894255= "
- Label4 . Text
- " &entry.57904320= "
- Label5 . Text
- " &entry.1685987106= "
- Label6 . Text
- " &entry.2041901179= "
- Activity . Text

when Button1 .Click

do open another screen screenName Screen1



We used Python pandas
scikit-learn joblib
script to generate

Model Accuracy: 0.9571
Model saved to fall detection

Server Development



```

when Clock1 .Timer
do
  set global name to AccelerometerSensor1 . XAccel
  set global name2 to AccelerometerSensor1 . YAccel
  set global name3 to AccelerometerSensor1 . ZAccel
  set global name4 to GyroscopeSensor1 . XAngularVelocity
  set global name5 to GyroscopeSensor1 . YAngularVelocity
  set global name6 to GyroscopeSensor1 . ZAngularVelocity
  set Web1 . Url to " http://192.168.1.7:5000/predict "
  set Web1 . RequestHeaders to [ make a dictionary key " Content-Type " value " application/json " ]
  call Web1 . PostText
    text [ make a dictionary key " accelerometer_x " value get global name ]
    key " accelerometer_y " value get global name2
    key " accelerometer_z " value get global name3
    key " gyroscope_x " value get global name4
    key " gyroscope_y " value get global name5
    key " gyroscope_z " value get global name6
when DevelopmentMode2 .Click
do
  open another screen screenName DevelopmentMode

```

```

when Web1 .GotText
url responseCode responseType responseContent
do
  if get responseCode = 200
  then
    set Label2 . Text to call Web1 .JsonTextDecodeWithDictionary
      jsonText get responseContent
    if get responseContent = " fall "
    then
      call Notifier1 .ShowAlert
        notice " Don't Worry, Services are on the way!!! "
      call PhoneCall1 .MakePhoneCall
      set Web2 . Url to " http://192.168.1.7:5000/emg "
      set Web2 . RequestHeaders to [ make a dictionary key " Content-Type " value " application/json " ]
      call Web2 . PostText
        text " emg "

```

```

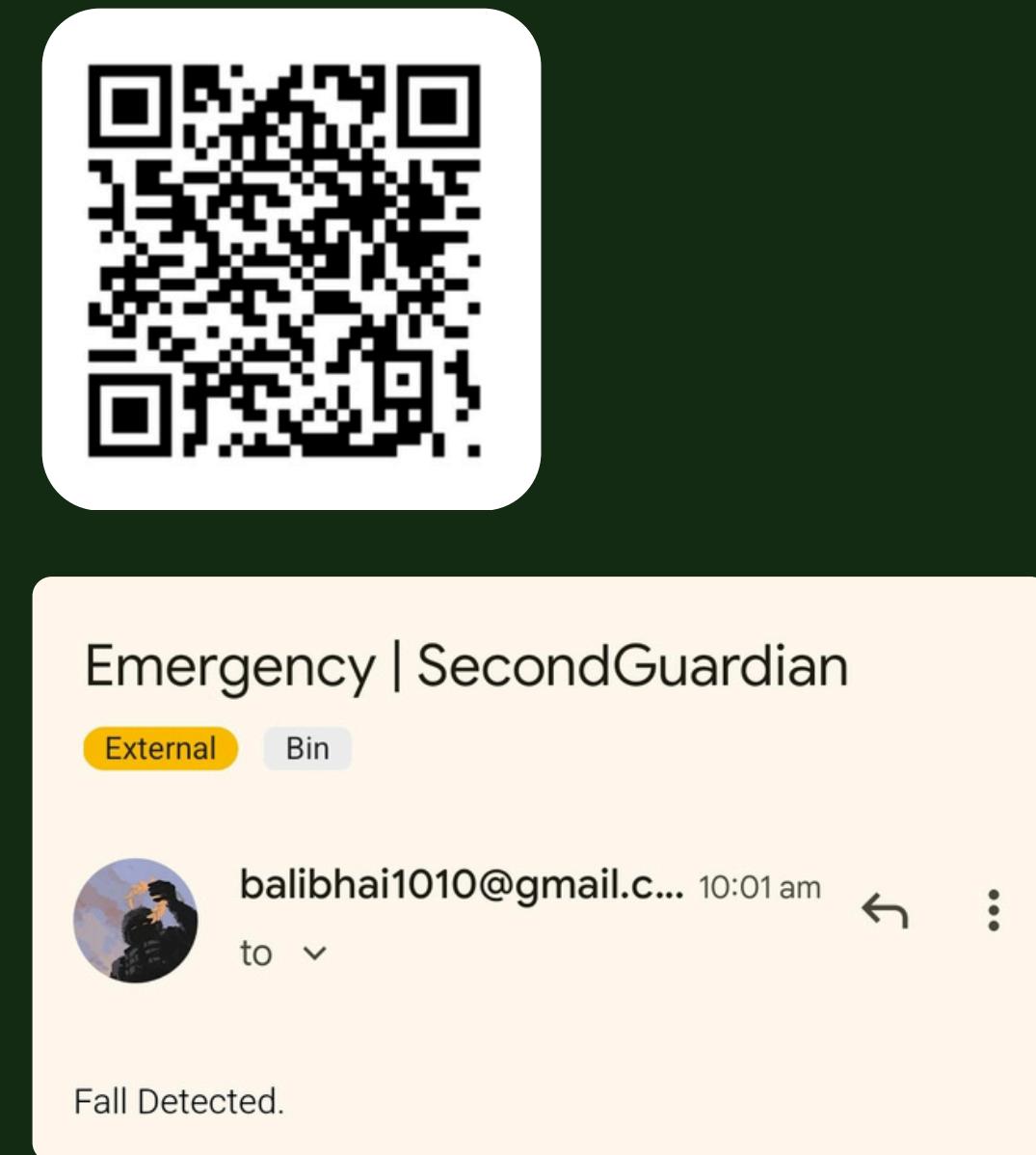
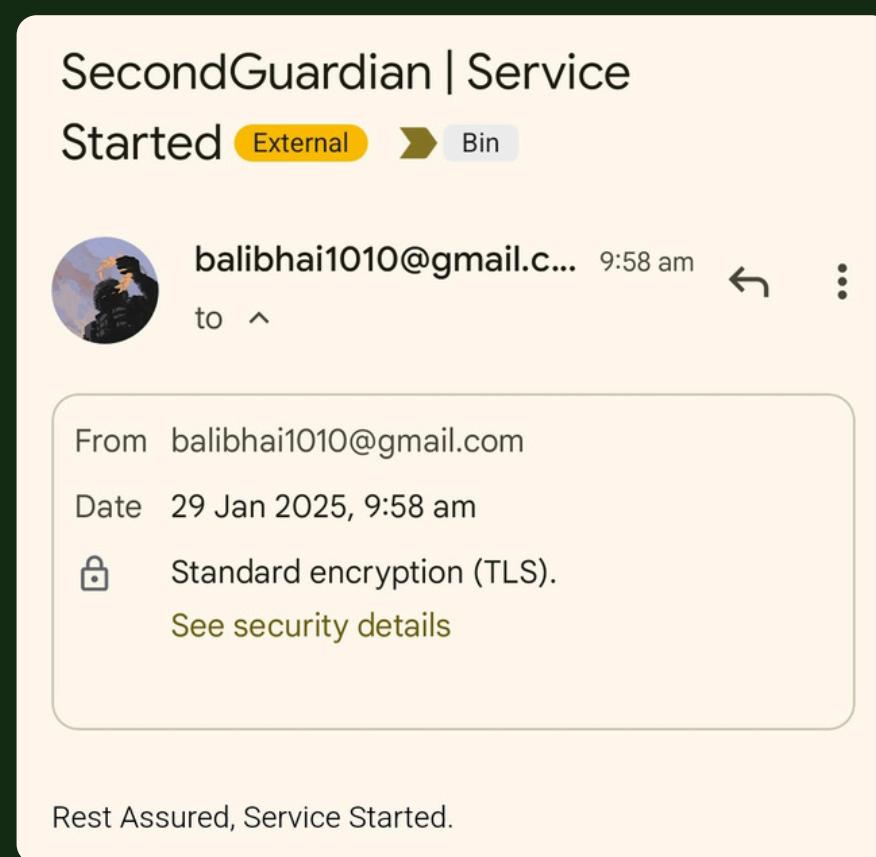
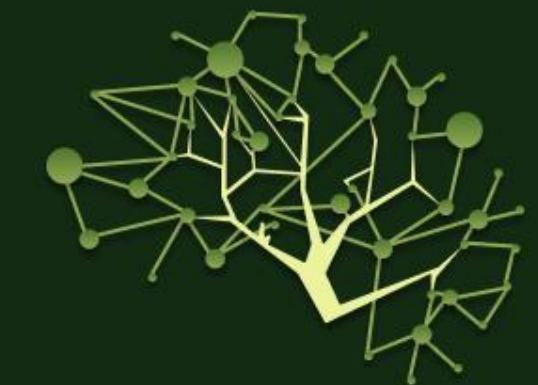
when CallButton .Click
do
  call PhoneCall1 .MakePhoneCall
  set Web2 . Url to " http://192.168.1.7:5000/emg "
  set Web2 . RequestHeaders to [ make a dictionary key " Content-Type " value " application/json " ]
  call Web2 . PostText
    text " emg "
  call Notifier1 .ShowAlert
    notice " Don't Worry, Services are on the way!!! "

```

We Used Flask Server { PublicIP 0.0.0.0 }
/predict : for fall detection
/emg : Mail Service when called at SOS or Fall detection.

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Production



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Thank You

