Data Generated!

	CPU_Usage	Memory_Usage	Keystrokes	Network_Activity	Keylogger
0	14.1	14.0	48	0.975913	1
1	2.0	14.0	47	0.010052	0
2	4.1	14.0	35	0.305178	0
3	3.9	14.0	5	0.553066	0
4	7.1	14.0	34	0.435796	0

Random Forest Accuracy: 100.00%

Random Forest Training Time: 0.16 seconds

	precision	recall	f1-score	support
0	1.00	1.00	1.00	86
1	1.00	1.00	1.00	14
accuracy			1.00	100
macro avg	1.00	1.00	1.00	100
weighted avg	1.00	1.00	1.00	100

Logistic Regression Accuracy: 95.00%

Logistic Regression Training Time: 0.00 seconds

	precision	recall	f1-score	support
0	0.95	1.00	0.97	86
1	1.00	0.64	0.78	14
accuracy			0.95	100

	precision	recall	f1-score	support
macro avg	0.97	0.82	0.88	100
weighted avg	0.95	0.95	0.95	100

/usr/local/lib/python3.11/dist-packages/keras/src/layers/rnn/rnn.py:200: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.

  super().__init__(**kwargs)

4/4 ━━━━━━━━━━━━━━━━━━━━━━ **1s** 112ms/step
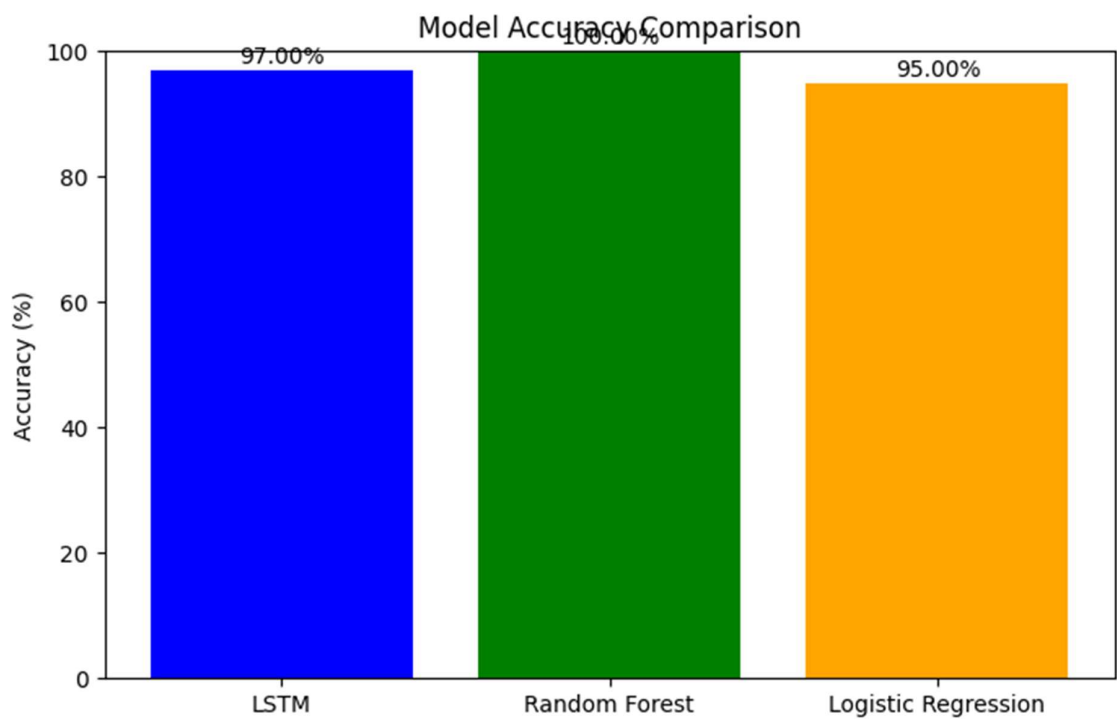
LSTM Accuracy: 97.00%

LSTM Training Time: 10.74 seconds

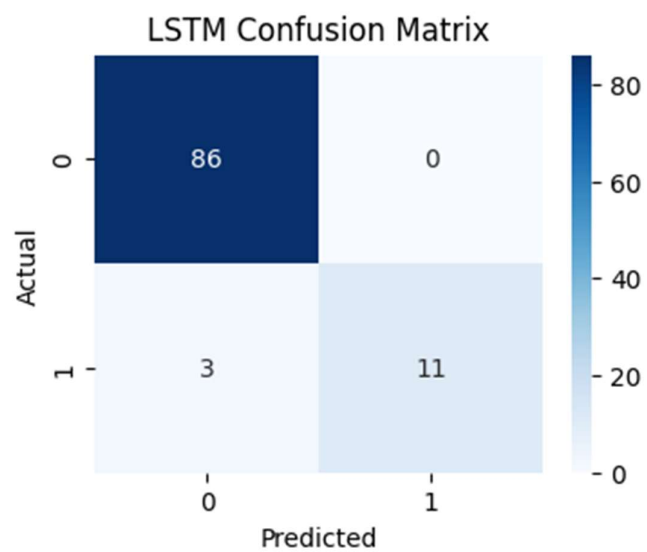|	precision	recall	f1-score	support
0	0.97	1.00	0.98	86
1	1.00	0.79	0.88	14
accuracy			0.97	100
macro avg	0.98	0.89	0.93	100
weighted avg	0.97	0.97	0.97	100

LSTM Accuracy Over Epochs

Model Accuracy Comparison

LSTM Confusion Matrix

	Predicted 0	Predicted 1
Actual 0	86	0
Actual 1	3	11

Random Forest Confusion Matrix

	Predicted 0	Predicted 1
Actual 0	86	0
Actual 1	0	14

Logistic Regression Confusion Matrix

ROC Curve Comparison

Random Forest (AUC = 1.00)
Logistic Regression (AUC = 1.00)
LSTM (AUC = 1.00)
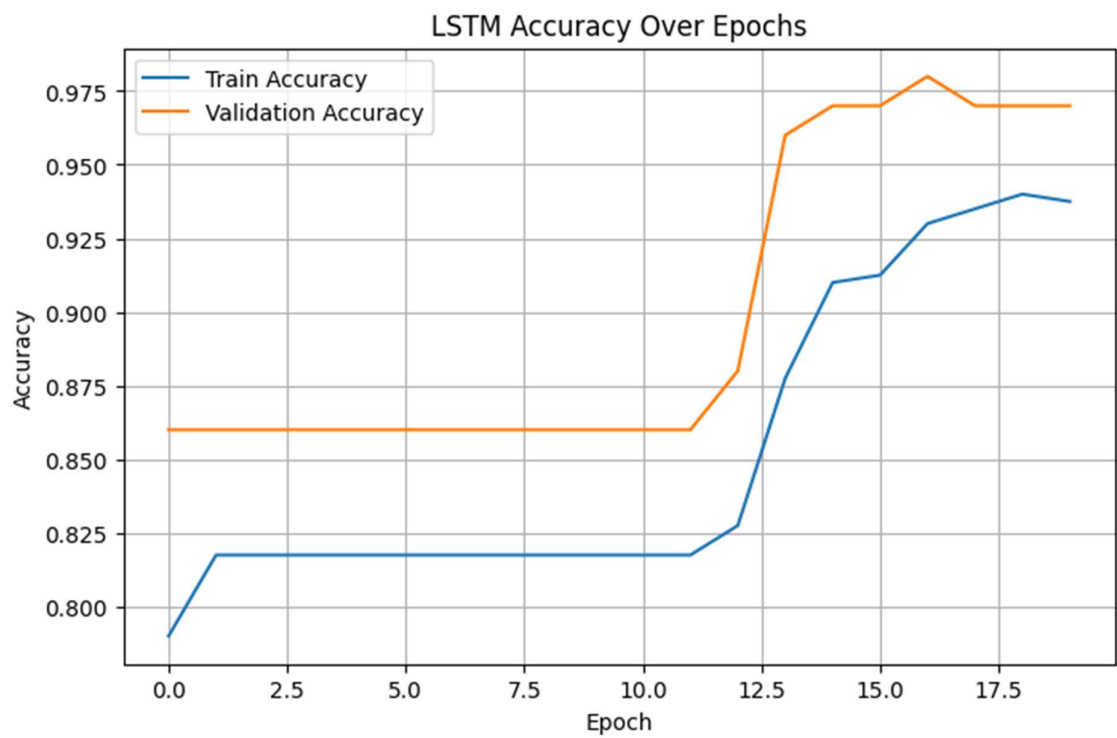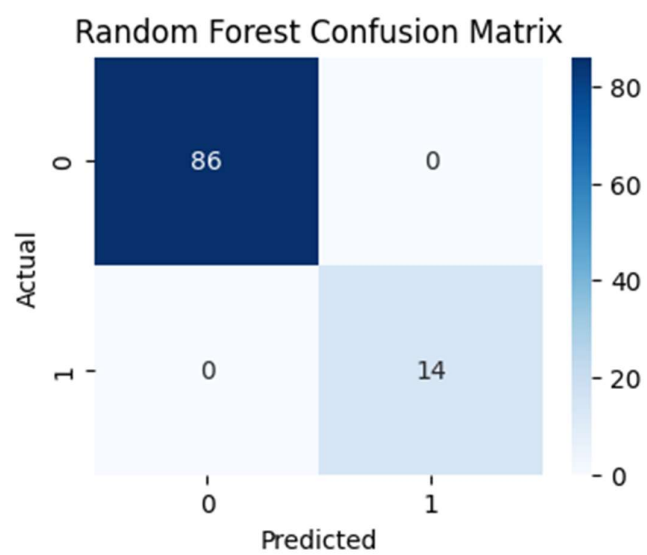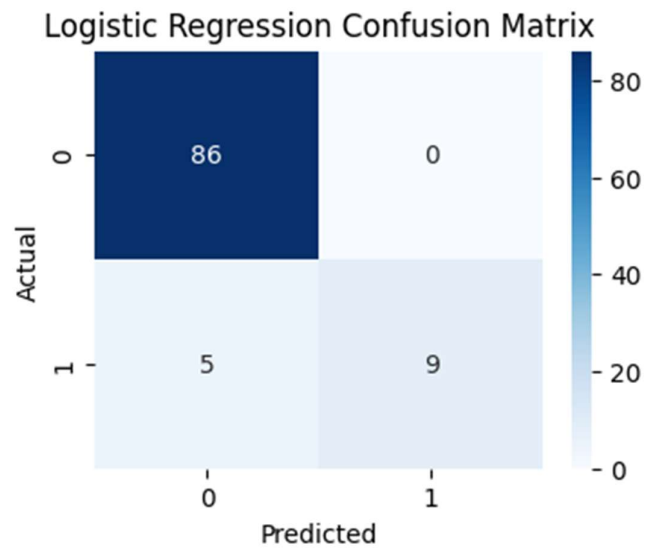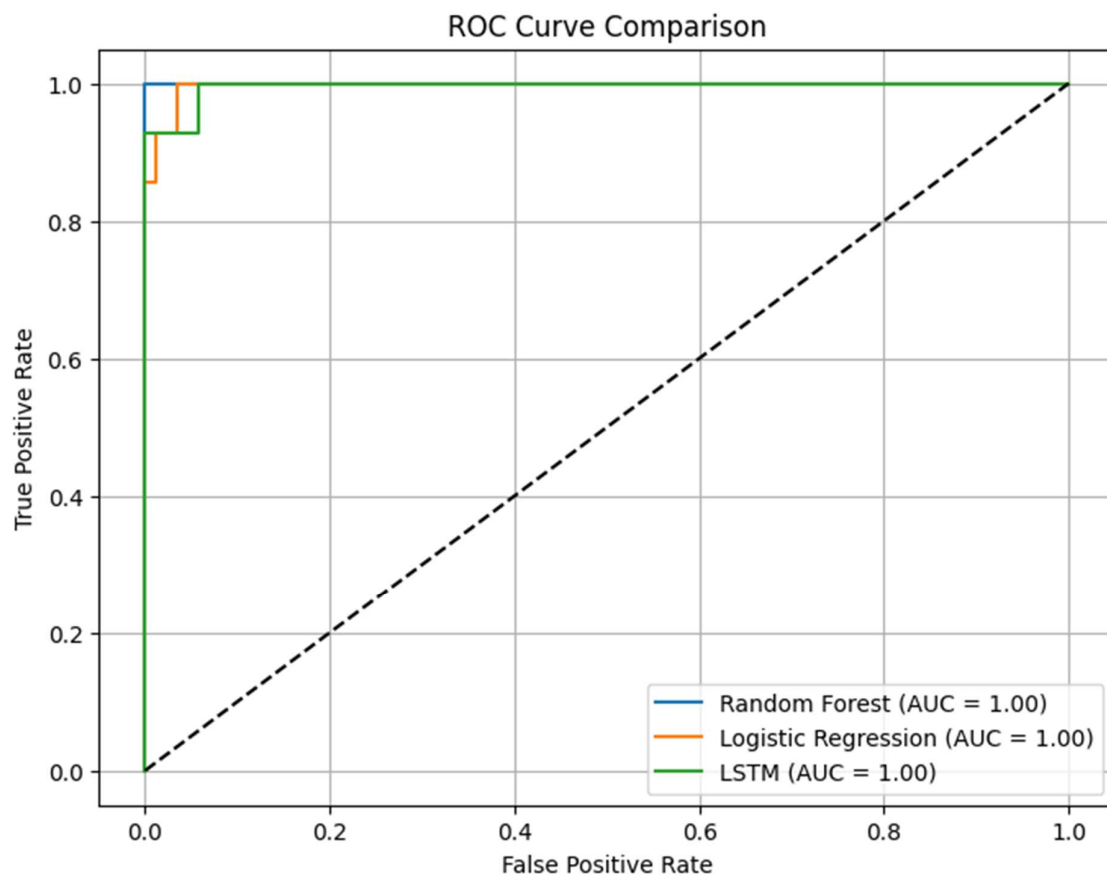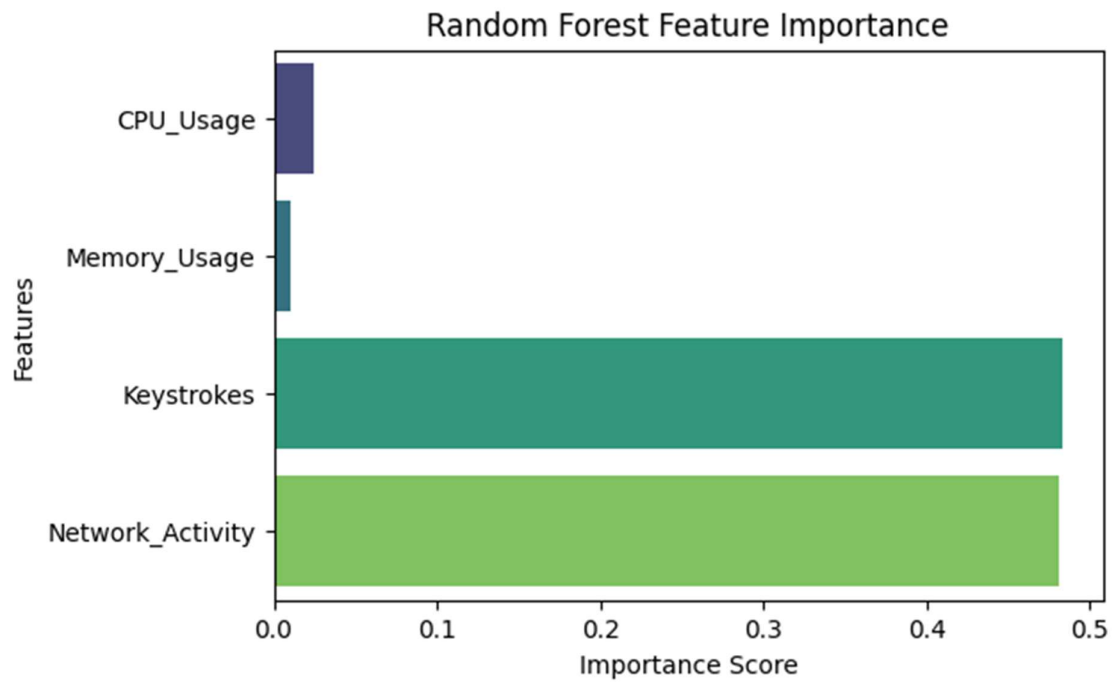
/tmp/ipython-input-4-3417591594.py:167: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `y` variable to `hue` and set `legend=False` for the same effect.

sns.barplot(x=importances, y=features, palette='viridis')

Random Forest Feature Importance

LSTM Model Summary:

Model: "sequential_1"

Layer (type)	Output Shape	Param #
lstm_2 (LSTM)	(None, 1, 64)	17,664
dropout_2 (Dropout)	(None, 1, 64)	0

lstm_3 (LSTM)	(None, 32)	12,416
dropout_3 (Dropout)	(None, 32)	0
dense_2 (Dense)	(None, 16)	528
dense_3 (Dense)	(None, 1)	17
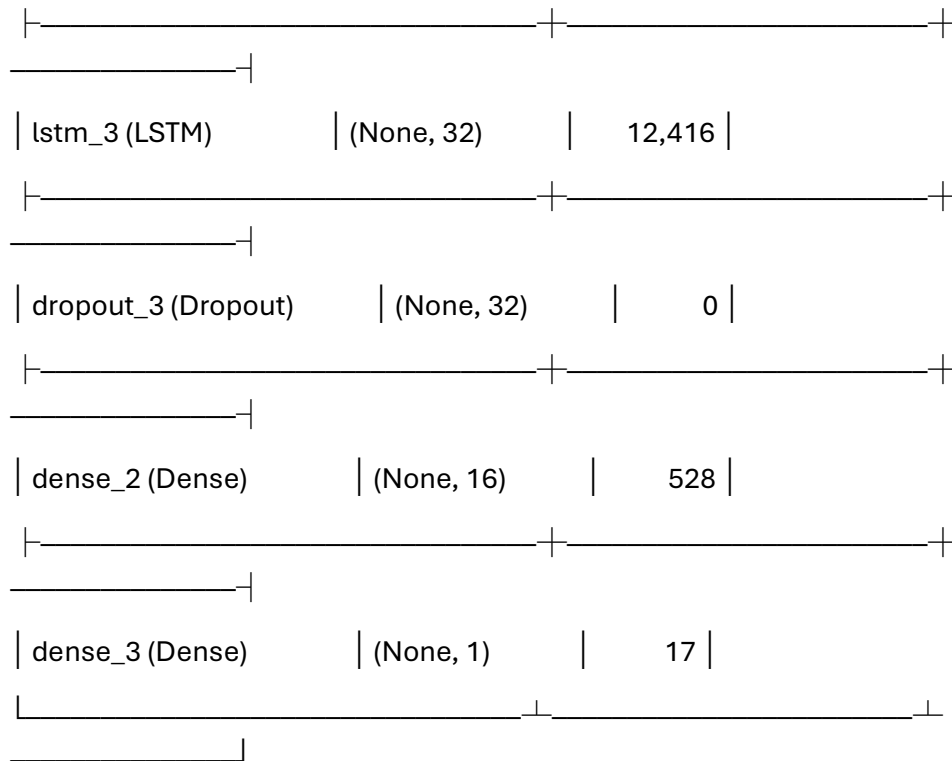
Total params: 91,877 (358.90 KB)

Trainable params: 30,625 (119.63 KB)

Non-trainable params: 0 (0.00 B)

Optimizer params: 61,252 (239.27 KB)

LSTM Threshold Sensitivity Analysis:

4/4 ─────────────────────── **0s** 11ms/step

Threshold 0.1 -> Accuracy: 87.00%

4/4 ─────────────────────── **0s** 8ms/step

Threshold 0.2 -> Accuracy: 92.00%

4/4 ─────────────────────── **0s** 9ms/step

Threshold 0.3 -> Accuracy: 96.00%

4/4 ─────────────────────── **0s** 9ms/step

Threshold 0.4 -> Accuracy: 99.00%

4/4 ─────────────────────── **0s** 19ms/step

Threshold 0.5 -> Accuracy: 97.00%

4/4 ———————————————————— **0s** 11ms/step

Threshold 0.6 -> Accuracy: 97.00%

4/4 ———————————————————— **0s** 10ms/step

Threshold 0.7 -> Accuracy: 95.00%

4/4 ———————————————————— **0s** 8ms/step

Threshold 0.8 -> Accuracy: 95.00%

4/4 ———————————————————— **0s** 12ms/step

Threshold 0.9 -> Accuracy: 92.00%

1/1 ———————————————————— **0s** 120ms/step

/usr/local/lib/python3.11/dist-packages/sklearn/utils/validation.py:2739: UserWarning: X does not have valid feature names, but MinMaxScaler was fitted with feature names

 warnings.warn(

Real-time Input - CPU: 56.1%, Mem: 13.7%, Keys: 5, Net: 0.93

System behavior is normal.

LSTM vs Logistic Regression - Performance Metrics

LSTM vs Logistic Regression - Scatter Plot of Performance Metrics

Line Chart - LSTM vs Logistic Regression Metrics