**Random Forest Classifier:**

**All the features, all the data & without scaling the data:**

|  |  |  |
| --- | --- | --- |
| Device | Accuracy | F1 Score |
| Danmin DoorBell | 1.0 | 1.0 |
| Ecobee\_Thermostat | 1.0 | 1.0 |
| Ennio\_Doorbell | 1.0 | 1.0 |
| Philips\_B120N10\_Baby\_Monitor | 1.0 | 1.0 |
| Provision\_PT\_737E\_Security\_Camera | 1.0 | 1.0 |
| Provision\_PT\_838\_Security\_Camera | 1.0 | 1.0 |
| Samsung\_SNH\_1011\_N\_Webcam | 1.0 | 1.0 |
| SimpleHome\_XCS7\_1002\_WHT\_Security\_Camera | 1.0 | 1.0 |
| SimpleHome\_XCS7\_1003\_WHT\_Security\_Camera | 1.0 | 1.0 |

**All the features, all the data & standard scaling the data:**

|  |  |  |
| --- | --- | --- |
| Device | Accuracy | F1 Score |
| Danmin DoorBell | 1.0 | 1.0 |
| Ecobee\_Thermostat | 1.0 | 1.0 |
| Ennio\_Doorbell | 1.0 | 1.0 |
| Philips\_B120N10\_Baby\_Monitor | 1.0 | 1.0 |
| Provision\_PT\_737E\_Security\_Camera | 1.0 | 1.0 |
| Provision\_PT\_838\_Security\_Camera | 1.0 | 1.0 |
| Samsung\_SNH\_1011\_N\_Webcam | 1.0 | 1.0 |
| SimpleHome\_XCS7\_1002\_WHT\_Security\_Camera | 1.0 | 1.0 |
| SimpleHome\_XCS7\_1003\_WHT\_Security\_Camera | 1.0 | 1.0 |

**All the features, under sampled data & without scaling the data:**

|  |  |  |
| --- | --- | --- |
| Device | Accuracy | F1 Score |
| Danmin DoorBell | 1.0 | 1.0 |
| Ecobee\_Thermostat | 1.0 | 1.0 |
| Ennio\_Doorbell | 1.0 | 1.0 |
| Philips\_B120N10\_Baby\_Monitor | 1.0 | 1.0 |
| Provision\_PT\_737E\_Security\_Camera | 1.0 | 1.0 |
| Provision\_PT\_838\_Security\_Camera | 1.0 | 1.0 |
| Samsung\_SNH\_1011\_N\_Webcam | 1.0 | 1.0 |
| SimpleHome\_XCS7\_1002\_WHT\_Security\_Camera | 1.0 | 1.0 |
| SimpleHome\_XCS7\_1003\_WHT\_Security\_Camera | 1.0 | 1.0 |

**All the features, under sampled data & standard scaling the data:**

|  |  |  |
| --- | --- | --- |
| Device | Accuracy | F1 Score |
| Danmin DoorBell | 1.0 | 1.0 |
| Ecobee\_Thermostat | 1.0 | 1.0 |
| Ennio\_Doorbell | 1.0 | 1.0 |
| Philips\_B120N10\_Baby\_Monitor | 1.0 | 1.0 |
| Provision\_PT\_737E\_Security\_Camera | 1.0 | 1.0 |
| Provision\_PT\_838\_Security\_Camera | 1.0 | 1.0 |
| Samsung\_SNH\_1011\_N\_Webcam | 1.0 | 1.0 |
| SimpleHome\_XCS7\_1002\_WHT\_Security\_Camera | 1.0 | 1.0 |
| SimpleHome\_XCS7\_1003\_WHT\_Security\_Camera | 1.0 | 1.0 |

**All the features, all the data & without scaling the data:**

**Danmin Doorbell**

Original Shape:(1018298, 115), (1018298,)

feature importance

MI\_dir\_L0.01\_weight 0.070

MI\_dir\_L1\_weight 0.055

MI\_dir\_L0.1\_weight 0.047

H\_L3\_weight 0.045

H\_L0.01\_weight 0.045

H\_L0.1\_weight 0.042

MI\_dir\_L5\_weight 0.035

MI\_dir\_L3\_weight 0.031

HH\_jit\_L3\_weight 0.031

H\_L0.01\_mean 0.030

MI\_dir\_L0.01\_mean 0.028

HH\_jit\_L3\_mean 0.026

H\_L5\_weight 0.024

H\_L1\_mean 0.024

H\_L1\_weight 0.024

HH\_L0.01\_magnitude 0.023

MI\_dir\_L0.1\_mean 0.023

H\_L0.1\_mean 0.022

HH\_L3\_weight 0.021

HH\_jit\_L1\_weight 0.021

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[ 15002 1 0]

[ 7 94852 0]

[ 0 0 195628]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 15003

gafgyt 1.00 1.00 1.00 94859

mirai 1.00 1.00 1.00 195628

accuracy 1.00 305490

macro avg 1.00 1.00 1.00 305490

weighted avg 1.00 1.00 1.00 305490

**Ecobee\_Thermostat**

Original Shape:(835876, 115), (835876,)

feature importance

H\_L5\_variance 0.078

MI\_dir\_L3\_variance 0.059

H\_L3\_variance 0.053

MI\_dir\_L0.1\_weight 0.049

H\_L0.1\_weight 0.046

MI\_dir\_L0.1\_mean 0.041

MI\_dir\_L3\_weight 0.034

MI\_dir\_L0.01\_mean 0.025

H\_L0.01\_weight 0.025

H\_L1\_weight 0.025

MI\_dir\_L1\_variance 0.025

MI\_dir\_L5\_variance 0.025

H\_L1\_variance 0.023

H\_L0.01\_variance 0.022

H\_L0.1\_mean 0.021

H\_L5\_weight 0.020

MI\_dir\_L1\_weight 0.019

MI\_dir\_L0.01\_weight 0.018

HH\_jit\_L3\_mean 0.018

H\_L3\_weight 0.018

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[ 4016 0 0]

[ 0 92806 0]

[ 1 0 153940]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 4016

gafgyt 1.00 1.00 1.00 92806

mirai 1.00 1.00 1.00 153941

accuracy 1.00 250763

macro avg 1.00 1.00 1.00 250763

weighted avg 1.00 1.00 1.00 250763

**Ennio\_Doorbell**

Original Shape:(355500, 115), (355500,)

feature importance

HH\_jit\_L0.1\_mean 0.110

MI\_dir\_L0.01\_mean 0.100

HH\_jit\_L0.01\_mean 0.093

H\_L0.01\_mean 0.074

HH\_L0.01\_magnitude 0.068

HH\_L0.01\_std 0.041

HH\_L0.01\_radius 0.040

HH\_L0.01\_mean 0.037

HH\_L0.1\_mean 0.035

H\_L0.1\_mean 0.031

HpHp\_L1\_mean 0.025

HH\_L5\_mean 0.025

HpHp\_L0.01\_mean 0.025

HpHp\_L5\_mean 0.021

HpHp\_L0.1\_mean 0.019

HH\_L1\_magnitude 0.017

HpHp\_L0.01\_std 0.017

HpHp\_L0.01\_weight 0.015

MI\_dir\_L0.1\_mean 0.015

HH\_L0.1\_std 0.013

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[11903 0]

[ 0 94747]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 11903

gafgyt 1.00 1.00 1.00 94747

accuracy 1.00 106650

macro avg 1.00 1.00 1.00 106650

weighted avg 1.00 1.00 1.00 106650

**All the features & all the data with standard scaling the data:**

**Danmin DoorBell**

Original Shape:(1018298, 115), (1018298,)

feature importance

H\_L0.01\_weight 0.074

MI\_dir\_L0.1\_weight 0.071

H\_L0.1\_weight 0.067

H\_L3\_weight 0.054

MI\_dir\_L0.01\_weight 0.049

MI\_dir\_L1\_weight 0.040

HH\_L3\_weight 0.031

H\_L1\_weight 0.031

HH\_L1\_weight 0.028

MI\_dir\_L0.01\_mean 0.027

H\_L0.1\_mean 0.027

H\_L0.01\_mean 0.023

H\_L5\_weight 0.022

MI\_dir\_L5\_weight 0.022

MI\_dir\_L3\_weight 0.022

MI\_dir\_L0.01\_variance 0.021

MI\_dir\_L0.1\_mean 0.021

MI\_dir\_L0.1\_variance 0.020

HH\_jit\_L0.1\_weight 0.019

H\_L0.1\_variance 0.018

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[ 15003 0 0]

[ 6 94853 0]

[ 0 0 195628]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 15003

gafgyt 1.00 1.00 1.00 94859

mirai 1.00 1.00 1.00 195628

accuracy 1.00 305490

macro avg 1.00 1.00 1.00 305490

weighted avg 1.00 1.00 1.00 305490

**Ecobee\_Thermostat**

Original Shape:(835876, 115), (835876,)

feature importance

H\_L3\_variance 0.072

MI\_dir\_L3\_variance 0.068

MI\_dir\_L5\_variance 0.061

H\_L5\_variance 0.051

MI\_dir\_L1\_weight 0.047

H\_L0.1\_weight 0.047

MI\_dir\_L0.01\_mean 0.039

H\_L1\_variance 0.030

MI\_dir\_L3\_weight 0.029

MI\_dir\_L1\_mean 0.028

MI\_dir\_L0.1\_weight 0.028

H\_L3\_weight 0.026

MI\_dir\_L0.1\_mean 0.024

H\_L1\_mean 0.023

H\_L5\_weight 0.021

HH\_jit\_L0.1\_weight 0.019

H\_L0.01\_weight 0.019

H\_L0.01\_mean 0.019

H\_L1\_weight 0.019

MI\_dir\_L1\_variance 0.018

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[ 4016 0 0]

[ 0 92806 0]

[ 1 0 153940]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 4016

gafgyt 1.00 1.00 1.00 92806

mirai 1.00 1.00 1.00 153941

accuracy 1.00 250763

macro avg 1.00 1.00 1.00 250763

weighted avg 1.00 1.00 1.00 250763

**Ennio\_Doorbell**

Original Shape:(355500, 115), (355500,)

feature importance

H\_L0.01\_mean 0.130

MI\_dir\_L0.01\_mean 0.104

HH\_jit\_L0.01\_mean 0.084

HH\_L0.01\_radius 0.076

H\_L0.1\_mean 0.054

HpHp\_L0.01\_weight 0.045

MI\_dir\_L0.1\_mean 0.042

HH\_L0.01\_std 0.038

HH\_L0.01\_mean 0.032

HH\_L0.1\_mean 0.031

HpHp\_L0.01\_mean 0.027

HH\_L0.01\_magnitude 0.027

HH\_L3\_mean 0.025

HH\_L5\_mean 0.025

HpHp\_L3\_mean 0.024

HpHp\_L1\_mean 0.019

H\_L3\_mean 0.016

MI\_dir\_L5\_mean 0.015

HH\_L1\_mean 0.013

HpHp\_L0.1\_mean 0.012

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[11903 0]

[ 0 94747]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 11903

gafgyt 1.00 1.00 1.00 94747

accuracy 1.00 106650

macro avg 1.00 1.00 1.00 106650

weighted avg 1.00 1.00 1.00 106650

**Philips\_B120N10\_Baby\_Monitor**

Original Shape:(1098677, 115), (1098677,)

feature importance

H\_L0.01\_weight 0.070

MI\_dir\_L0.1\_weight 0.070

MI\_dir\_L0.01\_weight 0.053

H\_L0.1\_weight 0.042

H\_L3\_weight 0.039

H\_L1\_weight 0.038

H\_L0.01\_mean 0.035

MI\_dir\_L1\_weight 0.033

MI\_dir\_L0.01\_mean 0.027

MI\_dir\_L3\_weight 0.026

HH\_L0.01\_radius 0.026

HH\_L0.01\_magnitude 0.023

HH\_jit\_L1\_weight 0.022

H\_L0.1\_variance 0.021

H\_L5\_weight 0.020

MI\_dir\_L5\_weight 0.019

HpHp\_L0.01\_std 0.019

HH\_L3\_weight 0.018

HH\_L1\_weight 0.017

MI\_dir\_L0.1\_mean 0.017

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[ 52497 1 0]

[ 2 93878 0]

[ 0 0 183226]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 52498

gafgyt 1.00 1.00 1.00 93880

mirai 1.00 1.00 1.00 183226

accuracy 1.00 329604

macro avg 1.00 1.00 1.00 329604

weighted avg 1.00 1.00 1.00 329604

**Provision\_PT\_737E\_Security\_Camera**

Original Shape:(828260, 115), (828260,)

feature importance

MI\_dir\_L0.1\_weight 0.110

H\_L0.1\_weight 0.081

MI\_dir\_L0.01\_weight 0.054

MI\_dir\_L0.1\_mean 0.040

MI\_dir\_L1\_weight 0.035

MI\_dir\_L0.01\_variance 0.033

H\_L0.01\_weight 0.032

HH\_L0.1\_weight 0.027

H\_L1\_weight 0.025

MI\_dir\_L3\_weight 0.024

HH\_jit\_L3\_mean 0.024

H\_L0.01\_variance 0.023

HH\_jit\_L1\_weight 0.022

MI\_dir\_L0.1\_variance 0.021

H\_L0.1\_variance 0.020

H\_L0.01\_mean 0.020

HH\_jit\_L0.1\_weight 0.018

H\_L0.1\_mean 0.017

HH\_L0.01\_std 0.017

H\_L1\_mean 0.016

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[ 18758 0 0]

[ 1 98604 1]

[ 0 0 131114]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 18758

gafgyt 1.00 1.00 1.00 98606

mirai 1.00 1.00 1.00 131114

accuracy 1.00 248478

macro avg 1.00 1.00 1.00 248478

weighted avg 1.00 1.00 1.00 248478

**Provision\_PT\_838\_Security\_Camera**

Original Shape:(836891, 115), (836891,)

feature importance

H\_L0.1\_weight 0.076

MI\_dir\_L0.1\_weight 0.065

MI\_dir\_L0.01\_weight 0.062

H\_L1\_weight 0.055

H\_L3\_weight 0.042

H\_L0.01\_weight 0.038

H\_L0.1\_mean 0.031

HH\_L1\_weight 0.030

HH\_jit\_L0.1\_weight 0.030

H\_L1\_mean 0.029

MI\_dir\_L1\_weight 0.028

MI\_dir\_L0.1\_mean 0.027

MI\_dir\_L3\_weight 0.026

MI\_dir\_L0.01\_mean 0.026

HH\_L0.1\_weight 0.025

H\_L0.01\_mean 0.024

HH\_L3\_weight 0.023

HH\_jit\_L0.1\_mean 0.020

MI\_dir\_L0.01\_variance 0.016

HH\_jit\_L5\_mean 0.016

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[ 29698 0 0]

[ 1 92246 0]

[ 0 0 129123]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 29698

gafgyt 1.00 1.00 1.00 92247

mirai 1.00 1.00 1.00 129123

accuracy 1.00 251068

macro avg 1.00 1.00 1.00 251068

weighted avg 1.00 1.00 1.00 251068

**Samsung\_SNH\_1011\_N\_Webcam**

Original Shape:(375222, 115), (375222,)

feature importance

MI\_dir\_L0.1\_mean 0.116

H\_L0.1\_mean 0.109

MI\_dir\_L0.01\_mean 0.097

H\_L1\_mean 0.061

HH\_jit\_L0.01\_mean 0.058

H\_L0.01\_mean 0.057

MI\_dir\_L0.01\_variance 0.055

H\_L0.01\_variance 0.053

MI\_dir\_L0.1\_variance 0.042

HpHp\_L0.01\_weight 0.037

HpHp\_L0.1\_mean 0.035

HH\_L0.01\_radius 0.033

HH\_L0.01\_mean 0.033

MI\_dir\_L1\_mean 0.027

H\_L0.1\_variance 0.025

HH\_L0.01\_magnitude 0.025

HH\_L1\_mean 0.018

HpHp\_L5\_magnitude 0.017

HpHp\_L1\_mean 0.016

HpHp\_L0.01\_mean 0.016

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[15682 2]

[ 8 96875]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 15684

gafgyt 1.00 1.00 1.00 96883

accuracy 1.00 112567

macro avg 1.00 1.00 1.00 112567

weighted avg 1.00 1.00 1.00 112567

**SimpleHome\_XCS7\_1002\_WHT\_Security\_Camera**

Original Shape:(863056, 115), (863056,)

feature importance

H\_L0.1\_weight 0.086

MI\_dir\_L5\_variance 0.050

MI\_dir\_L0.1\_weight 0.045

MI\_dir\_L3\_variance 0.039

H\_L0.1\_mean 0.034

H\_L1\_weight 0.033

MI\_dir\_L1\_weight 0.032

H\_L0.01\_mean 0.032

MI\_dir\_L0.01\_mean 0.032

H\_L0.01\_weight 0.030

H\_L5\_variance 0.030

MI\_dir\_L0.1\_mean 0.029

HH\_jit\_L1\_weight 0.025

H\_L5\_weight 0.024

H\_L0.01\_variance 0.023

MI\_dir\_L5\_weight 0.023

MI\_dir\_L1\_variance 0.020

MI\_dir\_L3\_weight 0.020

MI\_dir\_L0.1\_variance 0.019

H\_L3\_variance 0.019

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[ 14055 0 0]

[ 1 90532 0]

[ 1 0 154328]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 14055

gafgyt 1.00 1.00 1.00 90533

mirai 1.00 1.00 1.00 154329

accuracy 1.00 258917

macro avg 1.00 1.00 1.00 258917

weighted avg 1.00 1.00 1.00 258917

**SimpleHome\_XCS7\_1003\_WHT\_Security\_Camera**

Original Shape:(850826, 115), (850826,)

feature importance

MI\_dir\_L3\_variance 0.069

H\_L3\_variance 0.050

MI\_dir\_L0.1\_weight 0.050

MI\_dir\_L5\_variance 0.041

H\_L1\_variance 0.041

H\_L1\_weight 0.040

H\_L0.1\_weight 0.037

MI\_dir\_L3\_weight 0.037

MI\_dir\_L1\_weight 0.037

H\_L0.01\_mean 0.034

MI\_dir\_L1\_variance 0.033

H\_L0.01\_variance 0.030

H\_L0.01\_weight 0.026

MI\_dir\_L0.1\_mean 0.025

H\_L5\_variance 0.023

MI\_dir\_L0.01\_mean 0.023

H\_L3\_weight 0.023

HH\_L1\_weight 0.020

H\_L5\_mean 0.019

HH\_L0.01\_magnitude 0.019

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[ 5904 2 0]

[ 0 94511 0]

[ 1 1 154829]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 5906

gafgyt 1.00 1.00 1.00 94511

mirai 1.00 1.00 1.00 154831

accuracy 1.00 255248

macro avg 1.00 1.00 1.00 255248

weighted avg 1.00 1.00 1.00 255248

**All the features, under sampled data & without scaling the data:**

**Danmin DoorBell**

Original Shape:(1018298, 115), (1018298,)

Imblearn Shape:(148644, 115), (148644,)

feature importance

HH\_jit\_L5\_mean 0.105

HH\_jit\_L3\_mean 0.099

HH\_jit\_L0.01\_mean 0.083

HH\_jit\_L0.1\_mean 0.072

HH\_jit\_L1\_mean 0.072

MI\_dir\_L0.01\_mean 0.039

H\_L0.01\_mean 0.037

MI\_dir\_L0.1\_weight 0.035

H\_L0.1\_weight 0.031

HH\_L0.1\_magnitude 0.025

HH\_L0.01\_weight 0.025

HH\_jit\_L0.01\_weight 0.025

HpHp\_L5\_magnitude 0.021

HH\_L5\_magnitude 0.021

HH\_L0.01\_magnitude 0.020

HH\_jit\_L0.01\_variance 0.019

H\_L0.01\_variance 0.018

MI\_dir\_L0.01\_weight 0.016

HH\_L1\_magnitude 0.016

HH\_L3\_magnitude 0.016

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[14849 0 0]

[ 0 14860 0]

[ 1 0 14884]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 14849

gafgyt 1.00 1.00 1.00 14860

mirai 1.00 1.00 1.00 14885

accuracy 1.00 44594

macro avg 1.00 1.00 1.00 44594

weighted avg 1.00 1.00 1.00 44594

**Ecobee\_Thermostat**

Original Shape:(835876, 115), (835876,)

Imblearn Shape:(39339, 115), (39339,)

feature importance

HH\_jit\_L0.01\_mean 0.099

HH\_jit\_L0.1\_mean 0.094

HH\_jit\_L5\_mean 0.089

HH\_jit\_L1\_mean 0.087

HH\_jit\_L3\_mean 0.075

MI\_dir\_L0.01\_mean 0.049

HH\_L0.01\_weight 0.041

H\_L0.1\_weight 0.029

HH\_jit\_L0.01\_variance 0.025

HpHp\_L0.1\_weight 0.024

MI\_dir\_L0.1\_mean 0.024

HH\_jit\_L0.01\_weight 0.020

HpHp\_L0.01\_weight 0.020

MI\_dir\_L0.1\_weight 0.018

H\_L0.01\_mean 0.017

HH\_L0.1\_magnitude 0.016

H\_L5\_weight 0.014

HH\_L0.1\_weight 0.014

HpHp\_L3\_magnitude 0.014

H\_L0.01\_variance 0.012

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[3913 0 0]

[ 0 3891 0]

[ 0 0 3998]]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 3913

gafgyt 1.00 1.00 1.00 3891

mirai 1.00 1.00 1.00 3998

accuracy 1.00 11802

macro avg 1.00 1.00 1.00 11802

weighted avg 1.00 1.00 1.00 11802

**Ennio\_Doorbell**

Original Shape:(355500, 115), (355500,)

Imblearn Shape:(78200, 115), (78200,)

importance

feature

HH\_jit\_L3\_mean 0.083

HH\_L0.01\_weight 0.071

HH\_jit\_L5\_mean 0.064

HH\_jit\_L0.1\_mean 0.063

HH\_L5\_magnitude 0.060

HH\_L0.01\_magnitude 0.055

HH\_jit\_L1\_mean 0.051

HH\_jit\_L0.01\_variance 0.051

HH\_L0.1\_magnitude 0.050

HH\_jit\_L0.1\_weight 0.050

HH\_jit\_L0.01\_mean 0.042

MI\_dir\_L0.1\_weight 0.037

H\_L0.01\_mean 0.037

HH\_L0.1\_weight 0.031

HH\_L1\_magnitude 0.030

HH\_L0.01\_std 0.028

HH\_jit\_L0.01\_weight 0.021

H\_L0.01\_weight 0.020

MI\_dir\_L0.01\_weight 0.020

H\_L0.1\_mean 0.018

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[11788 0]

[ 0 11672]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 11788

gafgyt 1.00 1.00 1.00 11672

accuracy 1.00 23460

macro avg 1.00 1.00 1.00 23460

weighted avg 1.00 1.00 1.00 23460

**Philips\_B120N10\_Baby\_Monitor**

Original Shape:(1098677, 115), (1098677,)

Imblearn Shape:(525720, 115), (525720,)

importance

feature

HH\_jit\_L0.01\_mean 0.086

HH\_jit\_L1\_mean 0.080

HH\_jit\_L5\_mean 0.075

HH\_jit\_L3\_mean 0.066

HH\_jit\_L0.1\_mean 0.065

MI\_dir\_L0.1\_weight 0.051

H\_L0.1\_weight 0.046

HH\_L0.01\_magnitude 0.030

HH\_L1\_magnitude 0.030

HH\_jit\_L0.01\_variance 0.030

MI\_dir\_L3\_weight 0.028

HH\_L0.1\_magnitude 0.026

HH\_L0.01\_weight 0.025

HpHp\_L1\_magnitude 0.021

H\_L1\_weight 0.021

HH\_jit\_L0.1\_weight 0.020

HH\_jit\_L0.1\_variance 0.020

HH\_jit\_L0.01\_weight 0.020

H\_L1\_variance 0.019

HpHp\_L0.01\_magnitude 0.016

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[52311 0 0]

[ 0 52769 0]

[ 2 0 52634]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 52311

gafgyt 1.00 1.00 1.00 52769

mirai 1.00 1.00 1.00 52636

accuracy 1.00 157716

macro avg 1.00 1.00 1.00 157716

weighted avg 1.00 1.00 1.00 157716

**Provision\_PT\_737E\_Security\_Camera**

Original Shape:(828260, 115), (828260,)

Imblearn Shape:(186462, 115), (186462,)

importance

feature

HH\_jit\_L1\_mean 0.105

HH\_jit\_L0.01\_mean 0.081

HH\_jit\_L3\_mean 0.080

HH\_jit\_L0.1\_mean 0.080

H\_L0.1\_weight 0.079

HH\_jit\_L5\_mean 0.058

MI\_dir\_L0.1\_weight 0.040

HH\_jit\_L0.1\_variance 0.030

MI\_dir\_L0.01\_weight 0.030

H\_L0.01\_weight 0.027

HH\_jit\_L0.01\_weight 0.025

HH\_jit\_L0.01\_variance 0.021

H\_L0.1\_variance 0.021

HH\_jit\_L0.1\_weight 0.020

H\_L1\_weight 0.020

HH\_L0.01\_std 0.020

H\_L0.1\_mean 0.019

MI\_dir\_L1\_weight 0.017

HH\_L0.01\_weight 0.016

H\_L5\_weight 0.016

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[18587 0 0]

[ 0 18646 0]

[ 0 0 18706]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 18587

gafgyt 1.00 1.00 1.00 18646

mirai 1.00 1.00 1.00 18706

accuracy 1.00 55939

macro avg 1.00 1.00 1.00 55939

weighted avg 1.00 1.00 1.00 55939

**Provision\_PT\_838\_Security\_Camera**

Original Shape:(836891, 115), (836891,)

Imblearn Shape:(295542, 115), (295542,)

importance

feature

HH\_jit\_L3\_mean 0.097

HH\_jit\_L1\_mean 0.077

MI\_dir\_L0.1\_weight 0.072

HH\_jit\_L0.01\_variance 0.071

HH\_jit\_L5\_mean 0.067

HH\_jit\_L0.1\_mean 0.064

HH\_jit\_L0.01\_mean 0.063

MI\_dir\_L0.01\_weight 0.060

H\_L0.1\_weight 0.060

HH\_L0.01\_weight 0.031

MI\_dir\_L1\_weight 0.028

HH\_jit\_L0.01\_weight 0.026

HH\_jit\_L0.1\_weight 0.026

HH\_L0.01\_std 0.024

H\_L1\_weight 0.023

MI\_dir\_L0.1\_mean 0.022

HH\_jit\_L0.1\_variance 0.020

H\_L0.1\_variance 0.013

H\_L1\_mean 0.013

H\_L1\_variance 0.012

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[29478 0 0]

[ 0 29701 0]

[ 1 0 29483]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 29478

gafgyt 1.00 1.00 1.00 29701

mirai 1.00 1.00 1.00 29484

accuracy 1.00 88663

macro avg 1.00 1.00 1.00 88663

weighted avg 1.00 1.00 1.00 88663

**Samsung\_SNH\_1011\_N\_Webcam**

Original Shape:(375222, 115), (375222,)

Imblearn Shape:(104300, 115), (104300,)

Importance

feature

H\_L0.01\_mean 0.111

H\_L0.1\_mean 0.090

HH\_jit\_L1\_mean 0.084

MI\_dir\_L0.1\_mean 0.082

MI\_dir\_L0.01\_mean 0.061

HH\_jit\_L5\_mean 0.051

HH\_jit\_L0.01\_mean 0.051

HH\_jit\_L0.1\_weight 0.049

HH\_L0.1\_magnitude 0.047

HH\_L0.01\_magnitude 0.047

HH\_jit\_L3\_mean 0.041

HH\_jit\_L0.01\_variance 0.040

HH\_jit\_L0.1\_mean 0.040

HH\_jit\_L0.01\_weight 0.040

HpHp\_L0.1\_weight 0.030

HH\_L0.01\_weight 0.020

HpHp\_L3\_magnitude 0.019

HH\_L0.01\_std 0.019

H\_L0.01\_variance 0.010

HpHp\_L0.01\_weight 0.010

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[15642 0]

[ 0 15648]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 15642

gafgyt 1.00 1.00 1.00 15648

accuracy 1.00 31290

macro avg 1.00 1.00 1.00 31290

weighted avg 1.00 1.00 1.00 31290

**SimpleHome\_XCS7\_1002\_WHT\_Security\_Camera**

Original Shape:(863056, 115), (863056,)

Imblearn Shape:(139755, 115), (139755,)

importance

feature

HH\_jit\_L1\_mean 0.108

HH\_jit\_L0.01\_mean 0.101

HH\_jit\_L0.1\_mean 0.077

HH\_jit\_L3\_mean 0.072

HH\_jit\_L5\_mean 0.071

HH\_jit\_L0.1\_variance 0.035

HH\_L0.1\_magnitude 0.033

HH\_jit\_L0.01\_weight 0.030

MI\_dir\_L0.01\_mean 0.025

HH\_L1\_magnitude 0.025

HH\_L0.01\_weight 0.025

HH\_L5\_magnitude 0.025

HH\_jit\_L0.1\_weight 0.025

MI\_dir\_L1\_weight 0.023

HH\_L0.01\_magnitude 0.022

MI\_dir\_L0.1\_weight 0.020

HH\_L0.1\_weight 0.020

H\_L0.1\_weight 0.020

MI\_dir\_L3\_weight 0.017

H\_L1\_weight 0.016

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[13999 0 0]

[ 0 13971 0]

[ 0 0 13957]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 13999

gafgyt 1.00 1.00 1.00 13971

mirai 1.00 1.00 1.00 13957

accuracy 1.00 41927

macro avg 1.00 1.00 1.00 41927

weighted avg 1.00 1.00 1.00 41927

**SimpleHome\_XCS7\_1003\_WHT\_Security\_Camera**

Original Shape:(850826, 115), (850826,)

Imblearn Shape:(58584, 115), (58584,)

importance

feature

HH\_jit\_L1\_mean 0.096

HH\_jit\_L0.01\_mean 0.090

HH\_jit\_L3\_mean 0.089

HH\_jit\_L5\_mean 0.087

HH\_jit\_L0.1\_mean 0.059

H\_L0.01\_variance 0.052

MI\_dir\_L0.1\_weight 0.044

MI\_dir\_L0.1\_mean 0.044

H\_L0.1\_weight 0.032

H\_L0.1\_mean 0.027

H\_L0.01\_mean 0.023

MI\_dir\_L0.01\_mean 0.022

HH\_jit\_L0.1\_variance 0.021

MI\_dir\_L0.01\_variance 0.021

H\_L1\_weight 0.016

H\_L3\_weight 0.016

HH\_L0.01\_magnitude 0.015

H\_L0.1\_variance 0.015

HH\_jit\_L0.01\_variance 0.015

H\_L1\_mean 0.013

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[5743 0 0]

[ 0 5859 0]

[ 0 0 5974]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 5743

gafgyt 1.00 1.00 1.00 5859

mirai 1.00 1.00 1.00 5974

accuracy 1.00 17576

macro avg 1.00 1.00 1.00 17576

weighted avg 1.00 1.00 1.00 17576

**All the features, under sampled data & Standard scaling the data:**

**Danmin Door Bell**

Original Shape:(1018298, 115), (1018298,)

Imblearn Shape:(148644, 115), (148644,)

importance

feature

HH\_jit\_L1\_mean 0.096

HH\_jit\_L3\_mean 0.083

HH\_jit\_L5\_mean 0.072

HH\_jit\_L0.1\_mean 0.057

HH\_jit\_L0.01\_mean 0.056

MI\_dir\_L0.1\_weight 0.045

H\_L0.1\_weight 0.044

HH\_L1\_magnitude 0.040

H\_L0.01\_mean 0.035

MI\_dir\_L0.01\_mean 0.032

HH\_L0.1\_magnitude 0.031

HH\_L3\_magnitude 0.030

MI\_dir\_L0.01\_weight 0.029

HpHp\_L0.1\_magnitude 0.021

HH\_jit\_L0.01\_weight 0.020

H\_L0.01\_weight 0.019

H\_L1\_weight 0.017

MI\_dir\_L0.01\_variance 0.016

HH\_L5\_magnitude 0.016

HH\_L0.01\_magnitude 0.015

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[14849 0 0]

[ 0 14860 0]

[ 1 0 14884]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 14849

gafgyt 1.00 1.00 1.00 14860

mirai 1.00 1.00 1.00 14885

accuracy 1.00 44594

macro avg 1.00 1.00 1.00 44594

weighted avg 1.00 1.00 1.00 44594

**Ecobee\_Thermostat**

Original Shape:(835876, 115), (835876,)

Imblearn Shape:(39339, 115), (39339,)

importance

feature

HH\_jit\_L1\_mean 0.106

HH\_jit\_L0.1\_mean 0.096

HH\_jit\_L3\_mean 0.087

HH\_jit\_L5\_mean 0.080

HH\_jit\_L0.01\_mean 0.072

H\_L0.01\_mean 0.043

H\_L0.1\_weight 0.042

HH\_L0.01\_weight 0.040

HH\_L0.1\_weight 0.038

MI\_dir\_L0.01\_mean 0.036

HH\_jit\_L0.01\_weight 0.026

H\_L0.1\_mean 0.022

MI\_dir\_L0.1\_weight 0.021

MI\_dir\_L0.01\_variance 0.016

MI\_dir\_L1\_weight 0.015

HH\_L0.01\_magnitude 0.014

MI\_dir\_L1\_mean 0.014

HH\_jit\_L0.1\_weight 0.014

MI\_dir\_L0.1\_variance 0.014

H\_L3\_weight 0.011

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[3913 0 0]

[ 0 3891 0]

[ 0 0 3998]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 3913

gafgyt 1.00 1.00 1.00 3891

mirai 1.00 1.00 1.00 3998

accuracy 1.00 11802

macro avg 1.00 1.00 1.00 11802

weighted avg 1.00 1.00 1.00 11802

**Ennio\_Doorbell**

Original Shape:(355500, 115), (355500,)

Imblearn Shape:(78200, 115), (78200,)

importance

feature

HH\_jit\_L5\_mean 0.113

HH\_jit\_L0.1\_mean 0.091

HH\_jit\_L1\_mean 0.082

HH\_jit\_L0.01\_weight 0.080

HH\_jit\_L3\_mean 0.074

HH\_jit\_L0.01\_mean 0.063

HH\_L0.01\_weight 0.060

MI\_dir\_L0.01\_mean 0.056

HH\_jit\_L0.1\_weight 0.050

HH\_L0.01\_magnitude 0.049

HH\_L1\_magnitude 0.040

HH\_L0.1\_weight 0.030

HH\_L0.1\_magnitude 0.030

H\_L0.1\_variance 0.024

HH\_L5\_magnitude 0.020

HH\_L3\_magnitude 0.020

H\_L0.1\_weight 0.019

MI\_dir\_L0.1\_mean 0.018

MI\_dir\_L0.1\_variance 0.016

MI\_dir\_L0.01\_weight 0.013

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[11788 0]

[ 0 11672]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 11788

gafgyt 1.00 1.00 1.00 11672

accuracy 1.00 23460

macro avg 1.00 1.00 1.00 23460

weighted avg 1.00 1.00 1.00 23460

**Philips\_B120N10\_Baby\_Monitor**

Original Shape:(1098677, 115), (1098677,)

Imblearn Shape:(525720, 115), (525720,)

importance

feature

HH\_jit\_L1\_mean 0.119

HH\_jit\_L5\_mean 0.080

HH\_jit\_L3\_mean 0.075

HH\_jit\_L0.01\_mean 0.064

HH\_jit\_L0.1\_mean 0.056

HH\_L0.01\_magnitude 0.041

HH\_L0.1\_magnitude 0.041

H\_L0.1\_weight 0.039

MI\_dir\_L0.1\_weight 0.036

H\_L0.01\_weight 0.030

MI\_dir\_L1\_weight 0.029

MI\_dir\_L0.01\_weight 0.028

HH\_L0.1\_weight 0.025

HpHp\_L0.01\_weight 0.025

HH\_L0.01\_weight 0.025

HH\_L5\_magnitude 0.025

H\_L5\_weight 0.022

HpHp\_L3\_magnitude 0.020

H\_L1\_weight 0.019

HpHp\_L0.01\_magnitude 0.016

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[52311 0 0]

[ 0 52769 0]

[ 2 0 52634]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 52311

gafgyt 1.00 1.00 1.00 52769

mirai 1.00 1.00 1.00 52636

accuracy 1.00 157716

macro avg 1.00 1.00 1.00 157716

weighted avg 1.00 1.00 1.00 157716

**Provision\_PT\_737E\_Security\_Camera**

Original Shape:(828260, 115), (828260,)

Imblearn Shape:(186462, 115), (186462,)

importance

feature

HH\_jit\_L1\_mean 0.085

HH\_jit\_L0.1\_mean 0.083

HH\_jit\_L5\_mean 0.072

MI\_dir\_L0.1\_weight 0.072

HH\_jit\_L0.01\_mean 0.064

HH\_jit\_L3\_mean 0.062

HH\_jit\_L0.01\_weight 0.053

HH\_L0.1\_weight 0.042

MI\_dir\_L0.1\_mean 0.040

H\_L0.1\_weight 0.039

H\_L1\_weight 0.031

H\_L0.01\_weight 0.028

MI\_dir\_L0.01\_weight 0.028

MI\_dir\_L0.01\_variance 0.026

HH\_jit\_L0.1\_weight 0.025

MI\_dir\_L0.01\_mean 0.023

HH\_L0.01\_weight 0.021

H\_L0.1\_mean 0.019

H\_L0.1\_variance 0.019

H\_L0.01\_variance 0.018

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[18587 0 0]

[ 0 18646 0]

[ 0 0 18706]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 18587

gafgyt 1.00 1.00 1.00 18646

mirai 1.00 1.00 1.00 18706

accuracy 1.00 55939

macro avg 1.00 1.00 1.00 55939

weighted avg 1.00 1.00 1.00 55939

**Provision\_PT\_838\_Security\_Camera**

Original Shape:(836891, 115), (836891,)

Imblearn Shape:(295542, 115), (295542,)

importance

feature

HH\_jit\_L0.1\_mean 0.087

HH\_jit\_L0.01\_mean 0.085

HH\_jit\_L3\_mean 0.084

HH\_jit\_L1\_mean 0.073

HH\_jit\_L5\_mean 0.056

H\_L0.1\_weight 0.056

MI\_dir\_L0.1\_weight 0.044

H\_L0.01\_weight 0.043

HH\_L0.01\_weight 0.042

HH\_jit\_L0.01\_weight 0.037

MI\_dir\_L0.01\_weight 0.033

MI\_dir\_L0.1\_mean 0.031

HH\_jit\_L0.1\_weight 0.029

MI\_dir\_L1\_weight 0.028

H\_L0.01\_mean 0.024

H\_L1\_weight 0.023

MI\_dir\_L0.01\_variance 0.022

H\_L3\_weight 0.022

H\_L0.1\_mean 0.018

H\_L0.1\_variance 0.017

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[29478 0 0]

[ 0 29701 0]

[ 1 0 29483]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 29478

gafgyt 1.00 1.00 1.00 29701

mirai 1.00 1.00 1.00 29484

accuracy 1.00 88663

macro avg 1.00 1.00 1.00 88663

weighted avg 1.00 1.00 1.00 88663

**Samsung\_SNH\_1011\_N\_Webcam**

Original Shape:(375222, 115), (375222,)

Imblearn Shape:(104300, 115), (104300,)

importance

feature

HH\_jit\_L5\_mean 0.110

MI\_dir\_L0.1\_mean 0.085

HH\_jit\_L0.1\_mean 0.081

HH\_jit\_L3\_mean 0.073

HH\_jit\_L1\_mean 0.061

H\_L0.1\_mean 0.052

H\_L0.01\_mean 0.051

HpHp\_L0.1\_weight 0.048

HH\_jit\_L0.01\_mean 0.042

HH\_L0.01\_weight 0.040

HpHp\_L0.01\_magnitude 0.037

MI\_dir\_L0.01\_mean 0.031

HH\_jit\_L0.01\_weight 0.030

HH\_L0.1\_magnitude 0.028

HH\_L1\_magnitude 0.028

HH\_L5\_magnitude 0.028

H\_L0.01\_variance 0.022

HH\_L0.1\_weight 0.020

HpHp\_L0.01\_weight 0.020

HpHp\_L0.1\_magnitude 0.019

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[15642 0]

[ 0 15648]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 15642

gafgyt 1.00 1.00 1.00 15648

accuracy 1.00 31290

macro avg 1.00 1.00 1.00 31290

weighted avg 1.00 1.00 1.00 31290

**SimpleHome\_XCS7\_1002\_WHT\_Security\_Camera**

Original Shape:(863056, 115), (863056,)

Imblearn Shape:(139755, 115), (139755,)

importance

feature

HH\_jit\_L0.01\_mean 0.097

HH\_jit\_L0.1\_mean 0.091

HH\_jit\_L3\_mean 0.090

HH\_jit\_L1\_mean 0.069

HH\_jit\_L5\_mean 0.057

HH\_L0.01\_magnitude 0.050

HH\_L5\_magnitude 0.046

HH\_L3\_magnitude 0.040

H\_L0.1\_weight 0.037

HH\_jit\_L0.01\_weight 0.035

HH\_L1\_magnitude 0.030

HH\_L0.1\_magnitude 0.027

HpHp\_L0.1\_weight 0.025

H\_L3\_weight 0.025

MI\_dir\_L1\_weight 0.021

HH\_L0.01\_weight 0.020

HpHp\_L0.1\_magnitude 0.020

MI\_dir\_L0.1\_weight 0.019

MI\_dir\_L0.01\_mean 0.019

MI\_dir\_L3\_weight 0.018

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[13999 0 0]

[ 0 13971 0]

[ 0 0 13957]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 13999

gafgyt 1.00 1.00 1.00 13971

mirai 1.00 1.00 1.00 13957

accuracy 1.00 41927

macro avg 1.00 1.00 1.00 41927

weighted avg 1.00 1.00 1.00 41927

**SimpleHome\_XCS7\_1003\_WHT\_Security\_Camera**

Original Shape:(850826, 115), (850826,)

Imblearn Shape:(58584, 115), (58584,)

importance

feature

HH\_jit\_L0.01\_mean 0.106

HH\_jit\_L1\_mean 0.082

HH\_jit\_L3\_mean 0.082

HH\_jit\_L0.1\_mean 0.078

HH\_jit\_L5\_mean 0.069

MI\_dir\_L0.01\_mean 0.049

H\_L0.01\_mean 0.043

H\_L0.1\_mean 0.043

HH\_jit\_L0.01\_weight 0.030

MI\_dir\_L0.1\_mean 0.029

H\_L0.01\_variance 0.026

H\_L1\_weight 0.024

H\_L0.1\_weight 0.024

HpHp\_L0.01\_weight 0.021

MI\_dir\_L5\_weight 0.018

MI\_dir\_L0.1\_weight 0.016

MI\_dir\_L0.01\_variance 0.015

HH\_L0.01\_weight 0.015

HH\_L0.01\_magnitude 0.014

HH\_L1\_magnitude 0.014

Random Forest: Accuracy=1.000

Random Forest: f1-score=1.000

Random Forest: Confusion Matrix

[[5743 0 0]

[ 0 5859 0]

[ 0 0 5974]]

Random Forest: Classification Report

precision recall f1-score support

benign 1.00 1.00 1.00 5743

gafgyt 1.00 1.00 1.00 5859

mirai 1.00 1.00 1.00 5974

accuracy 1.00 17576

macro avg 1.00 1.00 1.00 17576

weighted avg 1.00 1.00 1.00 17576