BOXER: Preventing fraud by scanning credit cards

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Once upon a time in 2018
Hey, I want to be Don the jeweler
I don’t know anything about GEMS
Get a PhD in Gemology?

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https://www.gia.edu/gem-education/program-graduate-gemologist
May be look at credit cards, instead
You’re Don the Jeweler, pick the fugazi!
You’re Don the Jeweler, pick the fugazi!
Can we detect high-quality fakes?
But why do we care?
Card not present fraud happens when fraudsters steal credit card credentials of other people.

Image from "The Security Challenges of the Rhythmprint Authentication", Wongnarukane et al.
Card not present fraud happens when fraudsters steal credit card credentials of other people and use these stolen credentials to make purchases online or via an app without the physical card.

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Card Present Transaction
Card
Present
Transaction
Card Not Present Transaction
Card Present Fraud vs Card Not Present Fraud

Losses in $ mm vs Year

In fact, researchers found retailers will lose some $130 billion dollars in digital CNP fraud between 2018 - 2023.

Juniper Research
BOXER

https://www.animatedimages.org/img-animated-boxing-image-0031-88330.htm
Boxer: Client-side SDK and server to deter CNP fraud.
Boxer: How does it work

Boxer is used by the food delivery app to verify a suspicious transaction.
Overview: App detects a suspicious transaction and forwards the user to Boxer.
Overview: Boxer’s asks the user to scan their card.

Boxer performs OCR, analyzes the video frames for telltale signs of attacks and collects device signals.
Overview: Boxer’s client SDK sends this data to the Boxer server.
Overview: Boxer’s server decides if the transaction should proceed.
Boxer: Client SDK and server

Good Friends

Promotion
3 Spam Musubi $7.50
Add More Items

Promo Code
Subtotal $3.55
Tax & Fees $2.68
Delivery $3.99

Verify Card
For your security, we want to make sure it is really you. Please scan your payment card for verification.

Payment Card: 0442, 04/25

Verify Card
For your security, we want to make sure it is really you. Please scan your payment card for verification.

Payment Card: 0442, 04/25

Continue
Scan Card

Placing order...

Good Friends

Promotion
3 Spam Musubi $7.50
Add More Items

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Outline

- Image Analysis
- Device Signals
- Principles
- Evaluation
- Impact
- Conclusions
Image Analysis: OCR

Scan the card to extract card number and expiry and check what is on record

• Perform OCR on the card number and expiry
Image Analysis: BIN Check

Inspect the card image for tell tale signs of tampering.

- The image on the top has a Green Dot card number but no objects (like payment network, logo, etc.,)
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Inspect the card image for tell tale signs of tampering.

• The image on the top has a Green Dot card number but no objects (like payment network, logo, etc.,)

• The image on the bottom has a Green Dot BIN but a CHASE logo.
Detect ways of rendering fake card images.

- Detect a card image scanned off a phone by homing in on the edges
Image Analysis: Screen Detection

Detect ways of rendering fake card images.

- Detect a card image scanned off a phone by homing in on the edges
- Detect computer screens by detecting Moiré patterns
Device Signals: DeviceCheck and SafetyNet

Force the attacker to use genuine hardware and the real app.

- Use the private key embedded in the hardware to verify it is genuine
Device Signals: Secure Counting

Associate attacker activities with things that are expensive like iPhones and use that to rate limit.

- Track activities and increment a secure counter when these occur on the same device.
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- For instance, counting the number of cards added per device can limit the damage done by large scale hardware-based attacks.
Device Signals : Secure Counting

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- Track activities and increment a secure counter when these occur on the same device.
- For instance, counting the number of cards added per device can limit the damage done by large scale hardware-based attacks.
- Boxer’s secure counter is privacy preserving since it only identifies classes of devices and not each individual device.
Boxer design principles

Scan
Scan the card to extract relevant details and check what is on record

Inspect
Inspect the card image for tell tale signs of tampering.

Detect
Detect ways of rendering fake card images.

Force
Force the attacker to use genuine hardware

Associate
Associate attacker activities with things that are expensive for secure rate limiting.
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Image analysis

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Evaluation: Boxer’s net effect end to end.

We report results from an app that allowed users flagged by their system to verify themselves with Boxer.

For two weeks in February 2020, 45 users were sent to Boxer for verification.
Evaluation: Boxer’s net effect end to end.

35 of these users failed OCR and were blocked by Boxer.

A manual review by the app later confirmed all 35 users to have been fraudulent.
Evaluation: Boxer’s net effect end to end.

Of the remaining users, 8 passed Boxer’s challenge and were allowed to complete their transactions.

A manual review conducted by the app later confirmed Boxer’s decisions to be accurate.
Evaluation: Boxer’s net effect end to end.

Of the remaining 2 users, one was caught by Boxer’s secure counter and the other was flagged by Boxer’s screen detection.

The user caught by secure counter was confirmed by manual review to be a fraudster.

The other user caught by screen detection was confirmed to be a false positive by manual review.
Evaluation: Boxer’s net effect end to end.

Thus, Boxer recovered 89% of the app’s legitimate users without incurring additional fraud.
Impact

So far 323 apps have integrated Boxer, many of them have deployed Boxer in production.

Boxer has scanned over 10 million cards and is currently actively stopping fraud.
Conclusions

We introduced Boxer, a client-side SDK and server for preventing card-not-present-fraud.
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Boxer combines multiple image analysis techniques with a novel secure counting abstraction to provide a holistic solution to CNP attacks.

Boxer has been integrated into 323 apps. It has scanned 10 millions cards already and is currently actively stopping fraud in production.
Thank you.

Please email your questions to:
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or
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