

The Metamorphosis: Automatic Detection of Scaling Issues for Mobile Apps

《变形记》：移动应用程序缩放问题的自动检测

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<https://github.com/dVermin/dVermin>

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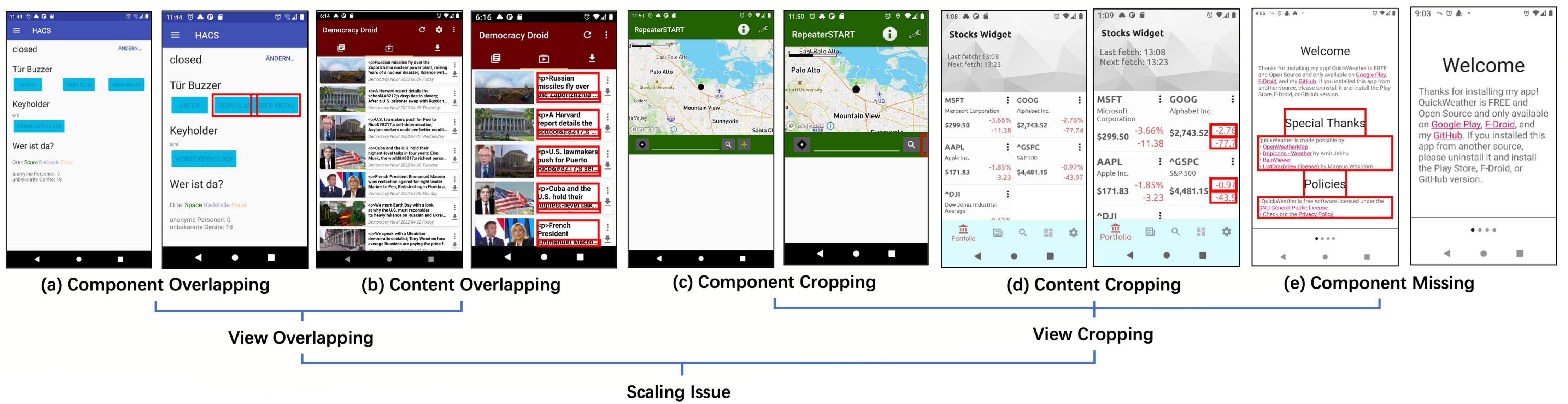


"The Metamorphosis"
Franz Kafka (1883-1924)

Introduction

- Graphical User Interface (GUI) is critical to the app accessibility.
- Scaling up the font or display size of GUI can help improve the visual impact, readability, and usability of an app, and is frequently used by the elderly and people with vision impairment.
- Yet scaling can easily lead to scaling issues such as text truncation, component overlap, which negatively influence the acquirement of the right information and the fluent usage of the app.

Motivational Study



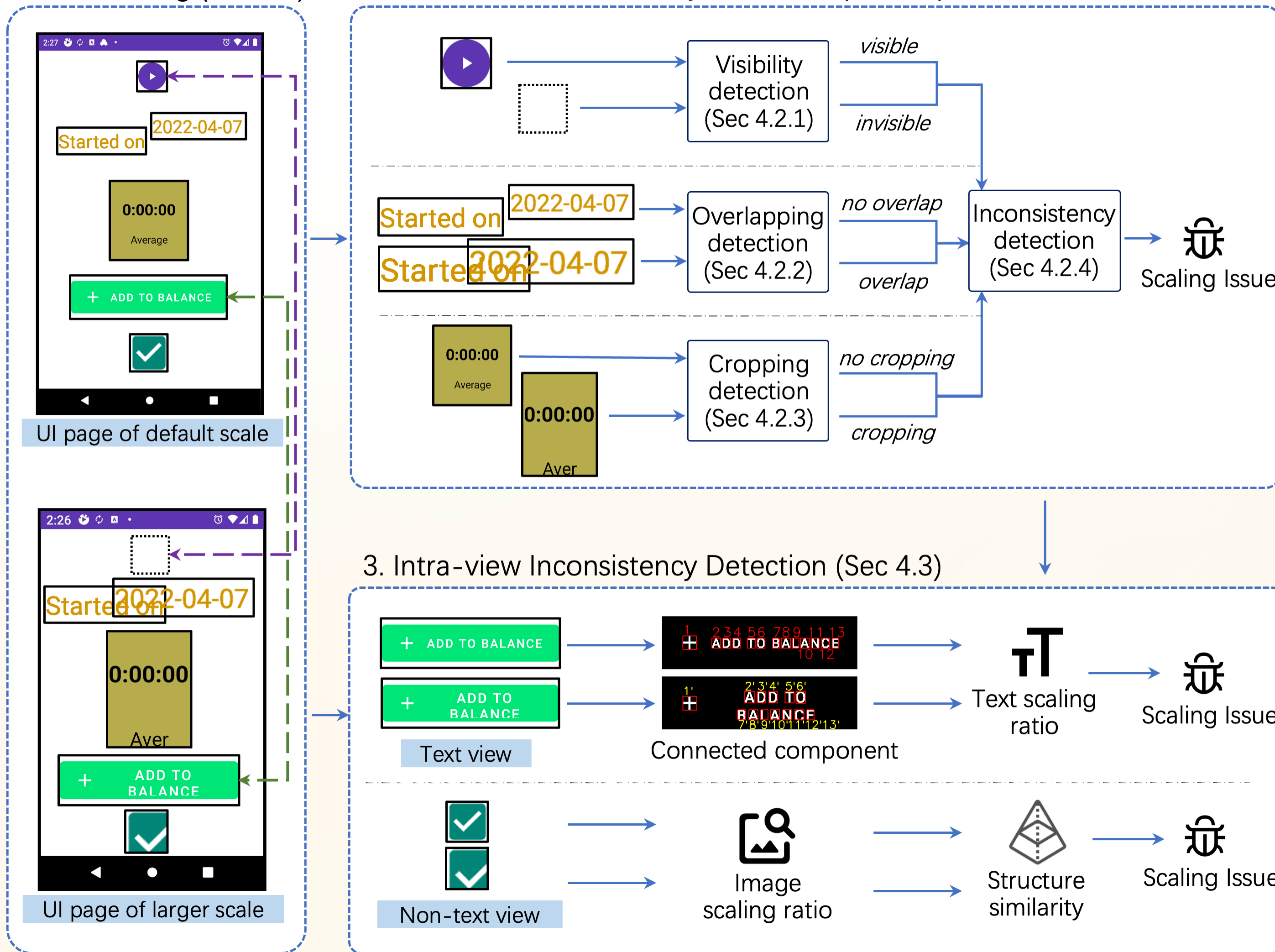
- We carry out a pilot study to examine the prevalence and type of scaling issues.
- 476 screenshots pairs collected, A total of 96 screenshots are determined as having scaling issues.
- Those scaling issues are classified into two categories with five sub-categories.

Method

- We propose an automated method, dVermin, for scaling issue detection.
- dVermin, "detect vermin", inspired by "The Metamorphosis" from Franz Kafka.

1. View Pairing (Sec 4.1)

2. Inter-view Inconsistency Detection (Sec 4.2)



View Pairing

For a page under default display scale and its counterpart under larger display scale, map component (view) with its counterpart.

Inter-View Inconsistency Detection

Detect overlapping/cropping between two components from a pair, and checks if the overlapping/cropping status are the same.

Intra-View Inconsistency Detection

For text view and non-text view, checks if there are any inconsistency for each single component in a page and its counterpart page with larger scale.

Evaluation & Result

Method	Type	Precision	Recall	F1-Score
dVermin	Bug	0.97	0.97	0.97
	Clean	0.92	0.92	0.92
OwlEyes	Bug	0.39	0.50	0.44
	Clean	0.78	0.69	0.73
DiffDroid	Bug	0.30	0.11	0.16
	Clean	0.71	0.90	0.80

RQ1: Issue Detection Performance

Method	Type	Precision	Recall	F1-Score
dVermin	Bug	0.84	0.91	0.88
	Clean	0.99	0.99	0.99
DiffDroid	Bug	0.11	0.11	0.11
	Clean	0.98	0.98	0.98

RQ2: Issue Localization Performance

dVermin outperforms two state-of-the-art baselines by a **large margin**.

No.	Issue Link ID	APP Name	Category	Version	Download	Status
1	304671	GPSLogger	Navig	112	1M+	fixed
2	810349	AlarmClock	Time	3.9.1	1M+	fixed
3	624992	PDFConverter	Tool	8.8.1	500K+	fixed
4	518169	WHWDataset	Tool	7.1.5	500K+	fixed
5	572599	EVMap	Health	0.8.3	500K+	fixed
6	767079	EinkBro	Internet	8.12.1	50K+	fixed
7	208094	Easer	Internet	0.8	50K+	fixed
8	564646	BabyDots	Tool	1.5	50K+	fixed
9	652416	Antimine	Tool	12.4.2	50K+	fixed
10	494843	BCWallet	Finance	8.16	50K+	confirmed
11	428996	TickMate	Health	1.4.12	10K+	fixed
12	211135	PicardCode	Media	1.5	10K+	fixed
13	797738	PleasTracker	Tool	7.1.5	10K+	fixed
14	876101	Silence	Navig	1.6.2	10K+	fixed
15	822374	WeeklyBudget	Finance	1.4	10K+	fixed
16	329138	OpenWeb	Internet	0.3	10K+	fixed
17	577533	DemoDroid	Social	4.2	10K+	fixed
18	546964	Badreads	Reading	0.1.6	10K+	fixed
19	701634	APKEditor	Tool	0.17	10K+	fixed
20	544654	UMLTracker	Tool	1.0	10K+	fixed
21	502273	OSMTracker	Tool	1.0.1	10K+	pending

RQ3: Usefulness Evaluation

dVermin uncovers **21** scaling issues with **20** of them being **confirmed/fixe**.