

Fragmented Innovation: Anime and the Limits of Computer Science R&D

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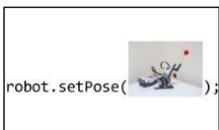
@junkato

<https://junkato.jp>

- The University of Tokyo Igarashi Lab '09 BSc, '11 MSc, '14 PhD
- Microsoft Research Asia '12/1-4 Research Intern / Microsoft Research '12/6-9 Research Intern
- Adobe Creative Technologies Lab, Seattle '13/8-11 Research Intern
- National Institute of Advanced Industrial Science and Technology (AIST) '14/4- Researcher, '18/10- Senior Researcher
- Arch Inc. '18/7- Technical Advisor (PI at R&D unit Arch Research)
- Universite Paris-Saclay '24/4-'25/3 Visiting Scientist



DeJaVu
[ACM UIST'12]



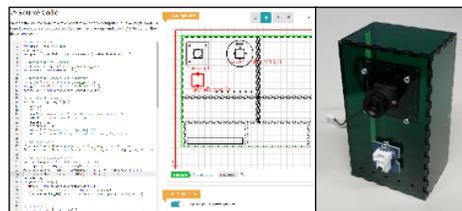
Picode
[ACM CHI'13]



TouchDevelop
[ACM PLDI'13]



TextAlive [ACM CHI'15]



f3.js [ACM DIS'17]



Lyric App Framework [ACM CHI'23]



Griffith [ACM CHI'24]

Human-Computer Interaction researcher **studying creative activities** e.g., programming, video authoring, storyboarding through **building and deploying creativity support tools**



Jun Kato, Kenta Hara, and Nao Hirasawa. 2024. Griffith: A Storyboarding Tool Designed with Japanese Animation Professionals. In Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems (CHI '24). Association for Computing Machinery, New York, NY, USA, Article 233, 1–14. <https://doi.org/10.1145/3613904.3642121>

Fragmented Innovation:

Anime and the Limits of Computer Science R&D

- **Industrial fragmentation**
- Academic reward system for formalization
- Institutional (and sometimes linguistic) filters



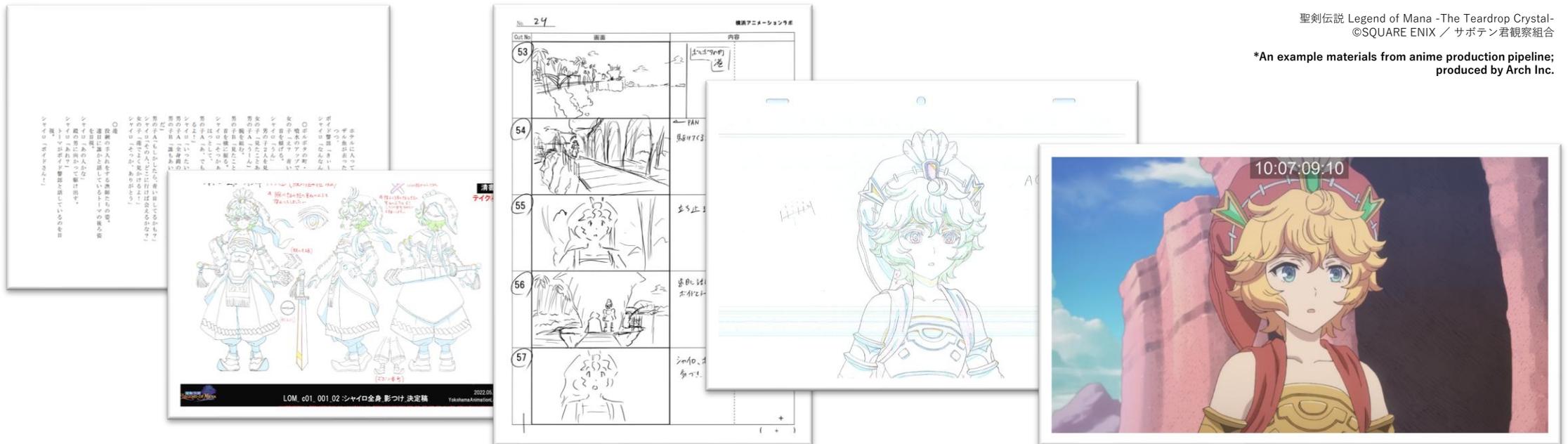
Anime is attracting both global and local attention

- A remarkable cultural accumulation since the **1950s**
- A growth industry: market size **doubled in 10 years**, and **overseas expanded fivefold** [\[AJA, 2025\]](#)
- Growing attention from **industry and government**, including the new Cool Japan strategy [\[Cabinet Office, 2024\]](#) and Entertainment Contents ∞ 2024 [\[Keidanren, 2024\]](#)



Research on anime production has been “undone”

- Massive data production: about **six cardboard boxes** per 30-minute episode in paper terms, and **hundreds of TB** of intermediate materials per day in full-digital workflows
- Complex production pipelines involving **hundreds of people**



Research on two-dimensional animation authoring has remained challenging ∙∙ for a long time

“

Why are computer graphics tools so difficult to apply to 2D animation? **It is not enough to simply solve technical problems.** The studio must also be convinced. Today's creation process is essentially a production line, in which a studio of 50 to 300 people work together to produce tens of thousands of drawings for a single feature film or television episode. Everyone has a specified role and follows detailed procedures to move from one stage to the next. Any attempt to computerize the traditional set of tasks must take into account **overhead costs** in both time and quality.

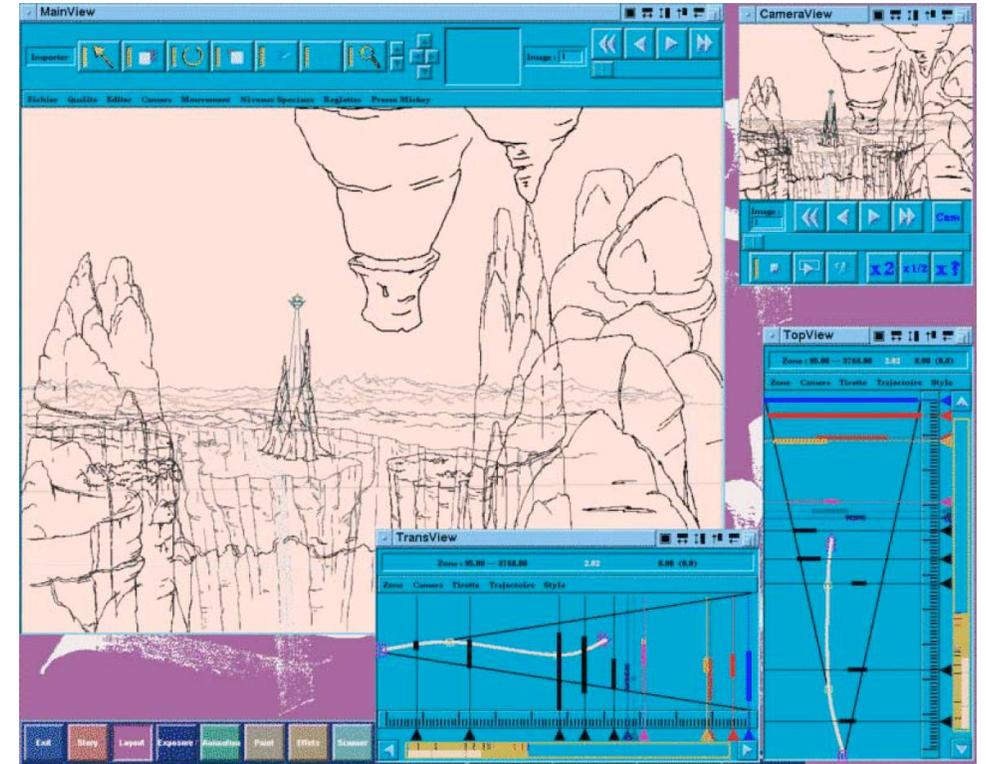
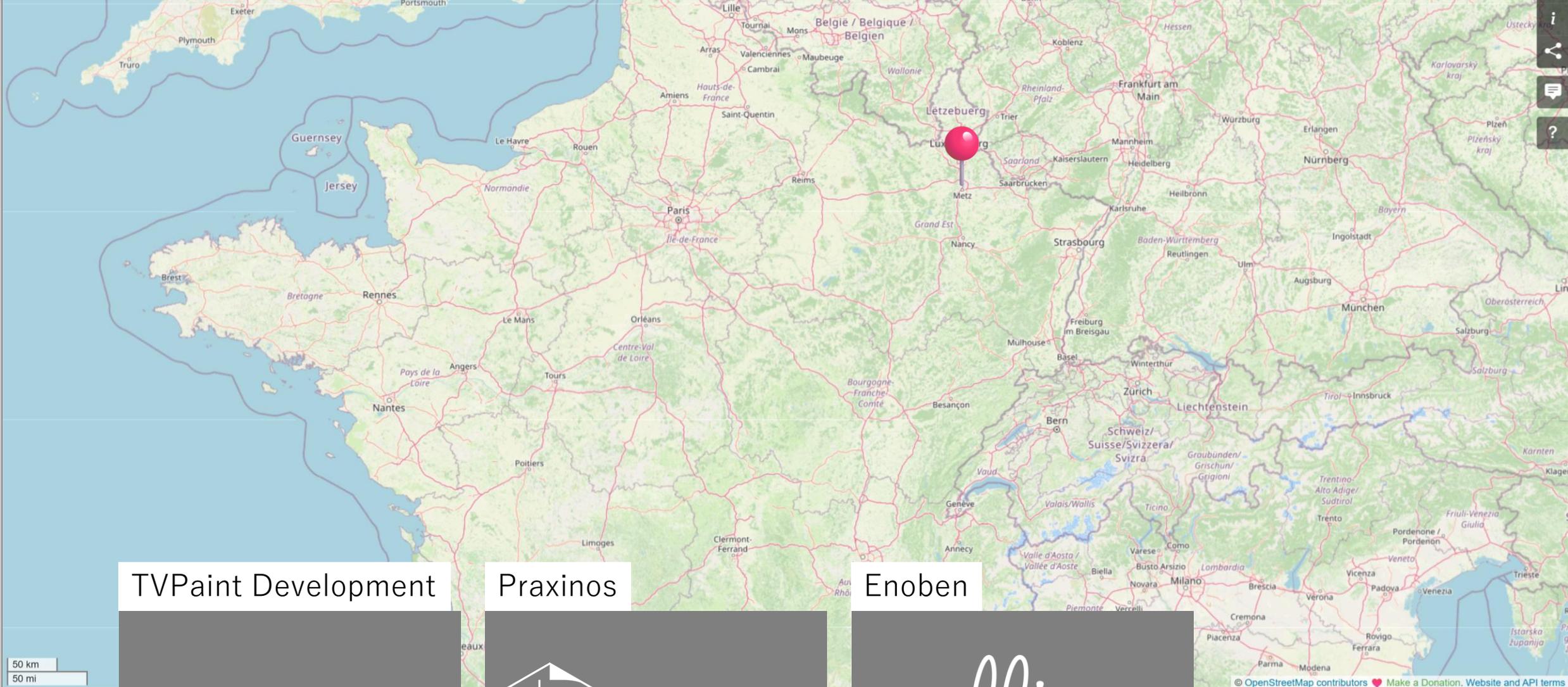


Figure 8: The Layout module showing a front view, top view and side view of a scene.

Jean-Daniel Fekete, Érick Bizouarn, Éric Cournarie, Thierry Galas, and Frédéric Taillefer. 1995. TicTacToon: a paperless system for professional 2D animation. In Proceedings of the 22nd annual conference on Computer graphics and interactive techniques (SIGGRAPH '95). Association for Computing Machinery, New York, NY, USA, 79–90. <https://doi.org/10.1145/218380.218417>



TVPaint Development



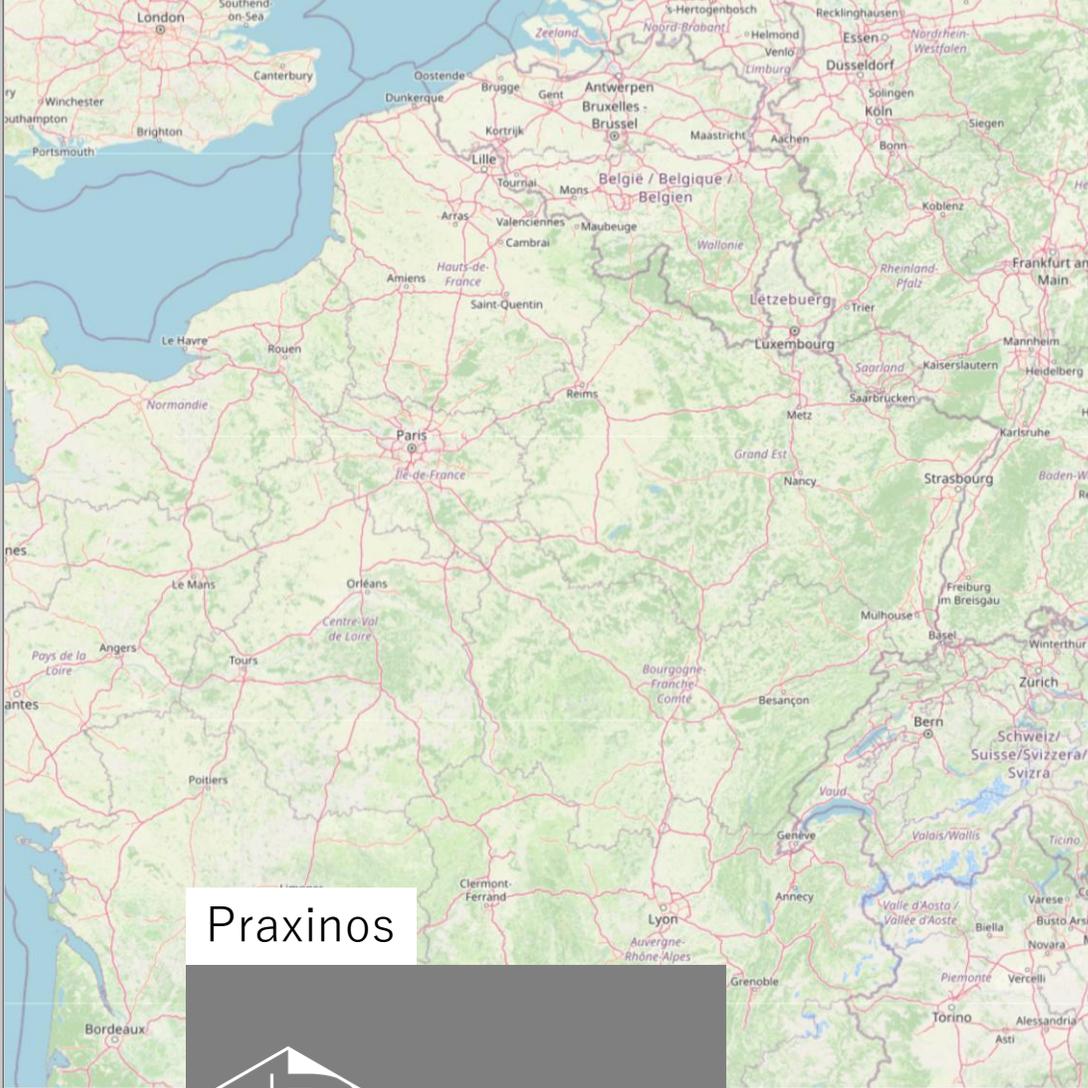
Praxinos



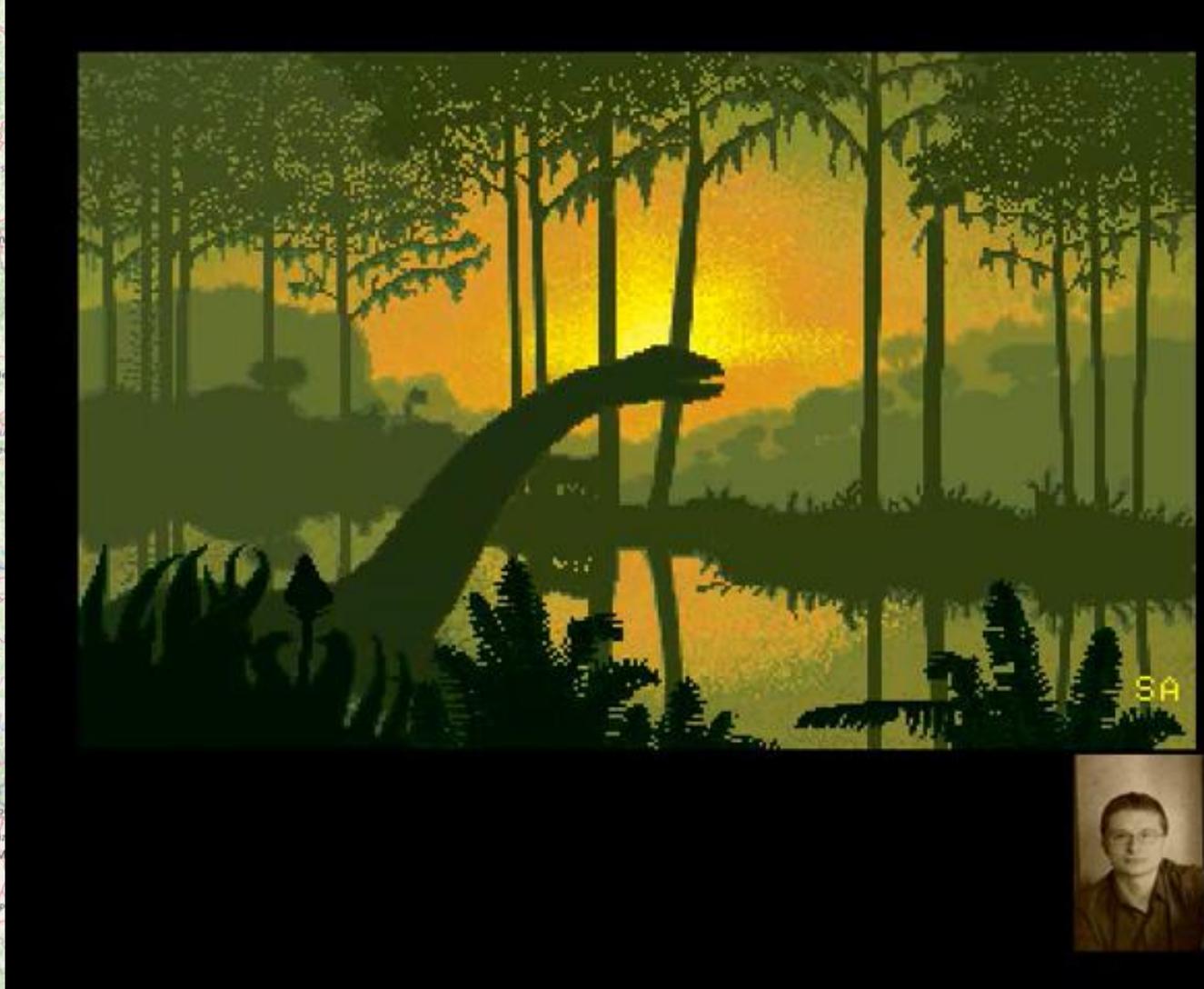
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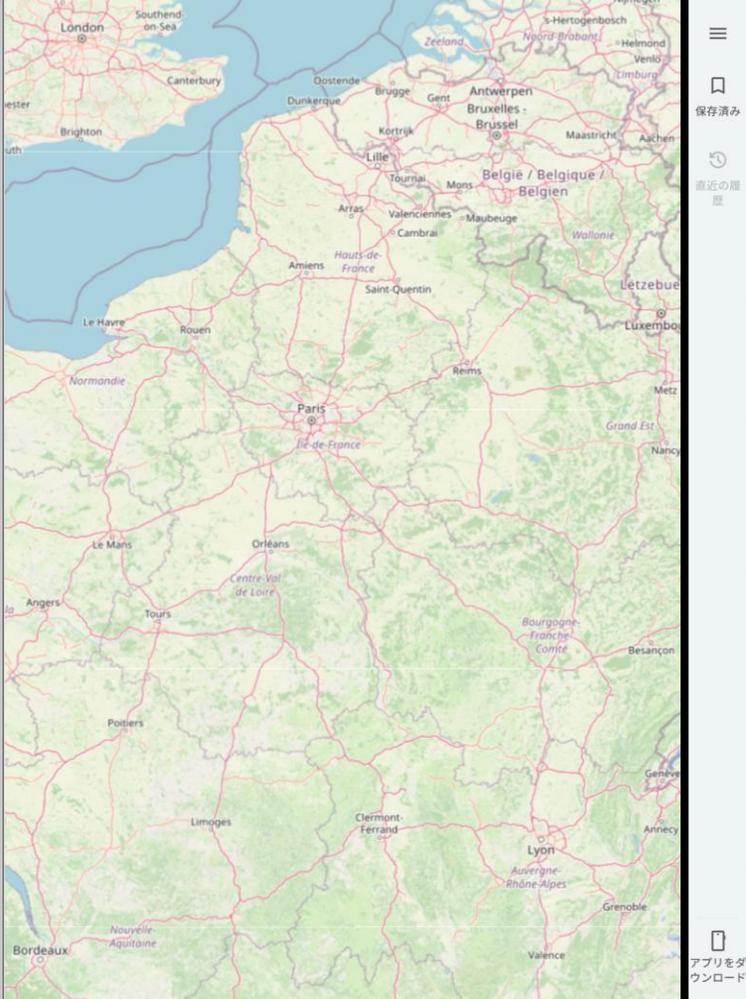
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Praxinos



<https://www.youtube.com/watch?v=p-bGsZuFZfw>



アニメーションスタジオ

結果

アニメ東京ステーション(アニメ東京)
 4.2 ★★★★★ (220)
 イベント会場・み・南池袋2丁目25-5
 藤久ビル 東五号館 B1F~2F
 営業時間外・営業開始: 11:00 (水)
 "2階は企画展示(期間限定)
 こちらについても無料でパネル展示が中心。"

株式会社ウィットスタジオ
 4.2 ★★★★★ (38)
 アニメ制作会社・中町1丁目19-3 武蔵野YSビル 5階
 営業時間外・営業開始: 10:00 (水)

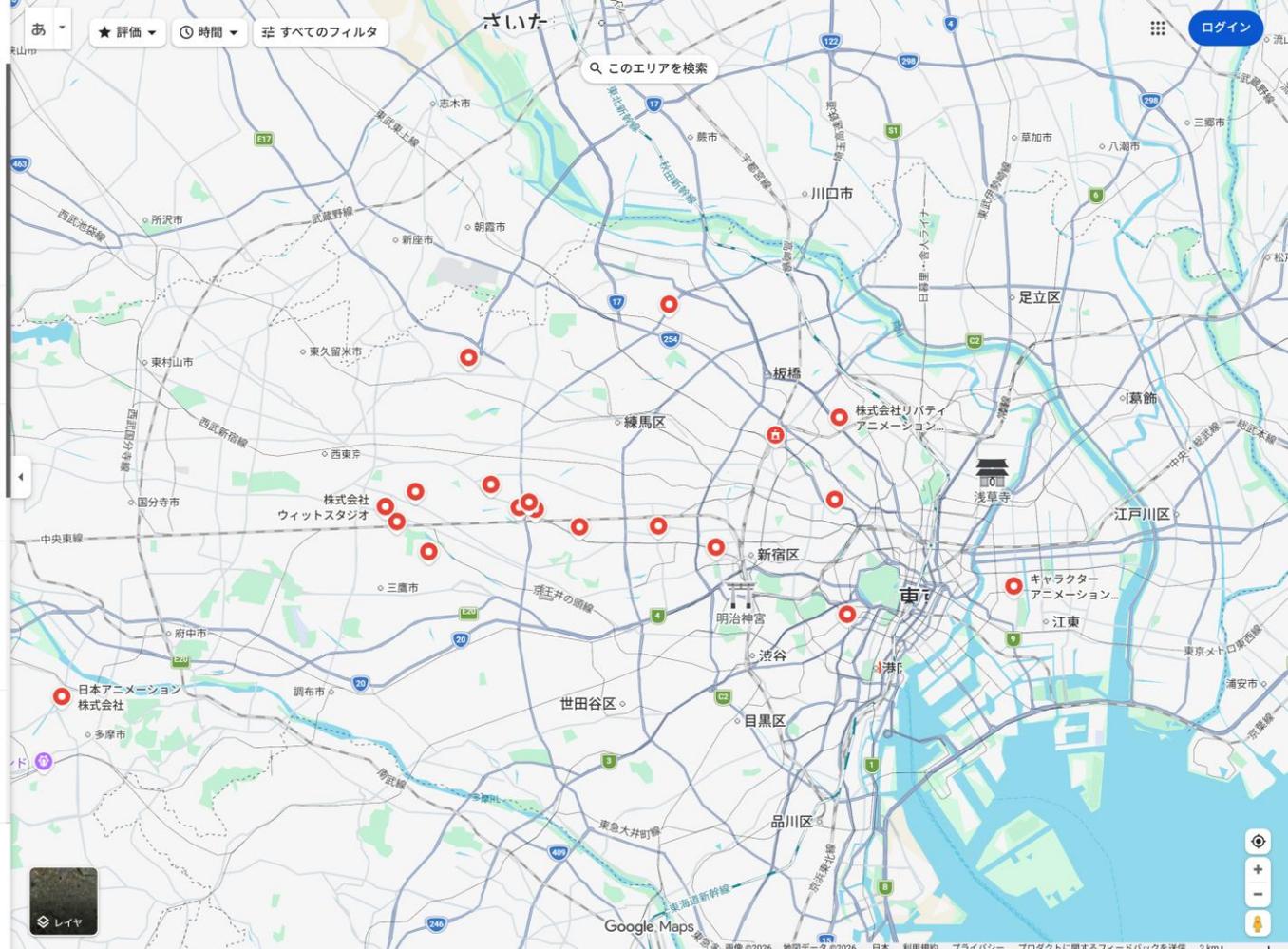
株式会社ダンディオンアニメーションスタジオ
 5.0 ★★★★★ (3)
 アニメ制作会社・東大泉2丁目7-2 8 三慶第2ビル
 営業時間外・営業開始: 10:00 (水)

日本アニメーション株式会社
 4.6 ★★★★★ (12)
 アニメ制作会社・和田2-1
 営業時間外・営業開始: 10:00 (水)
 "世界名作劇場、ちびまる子ちゃんなどを手掛けるアニメ製作会社"

株式会社A-1 Pictures
 4.4 ★★★★★ (56)
 アニメ制作会社・成田東4丁目38-1 8
 営業時間外・営業開始: 9:00 (水)
 "スタジオA1ピクチャーズにはアニメブレンドSが続いてほしいです"

Google マップを最大限に活用しましょう [ログイン](#)

地図の移動後に結果を更新

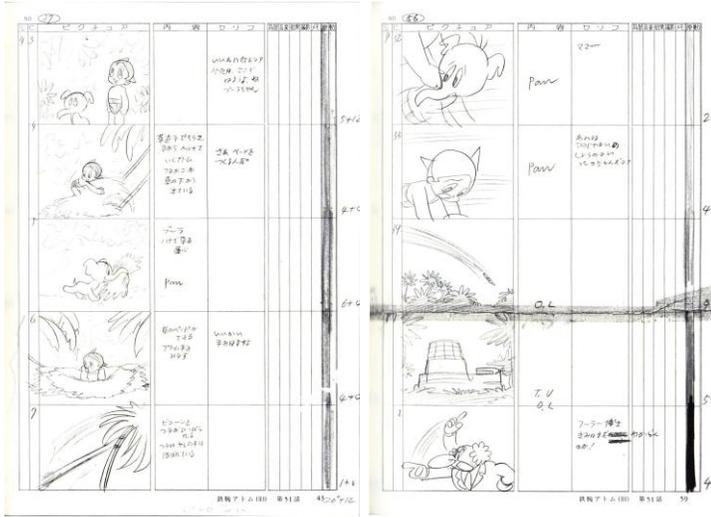


- Anime studios are **highly concentrated** in western Tokyo
- There has been less pressure to digitize, as materials could be **delivered physically** by bike or car

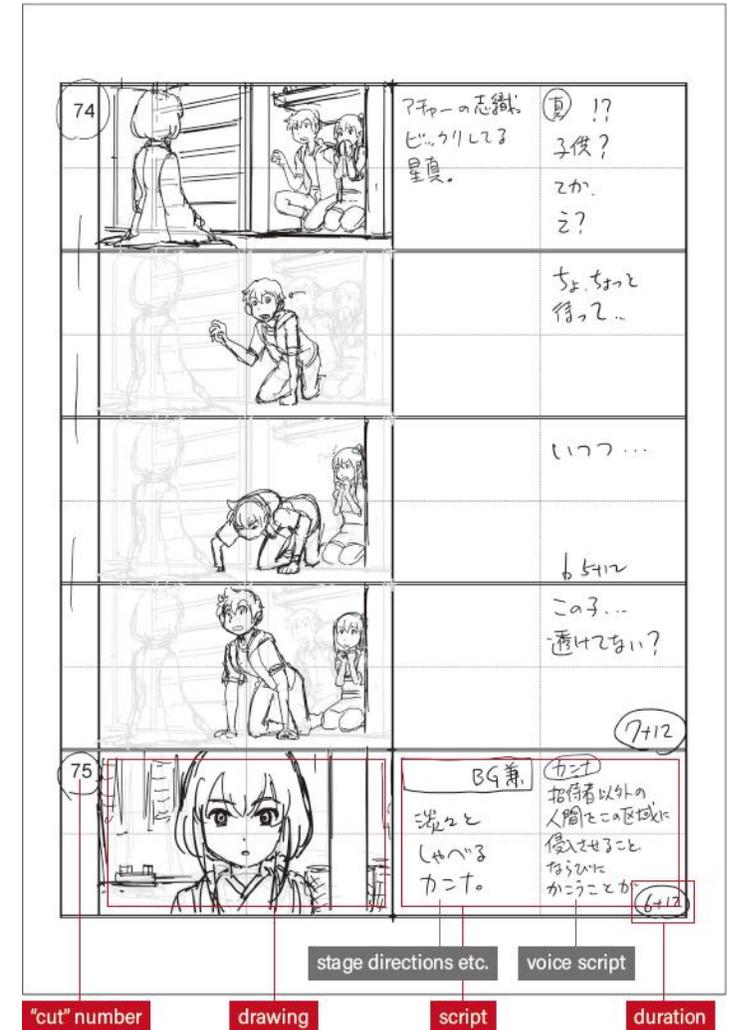
Highly collaborative nature resulted in “standards”



[Image] NHK,
https://www3.nhk.or.jp/news/special/sci_cul/2019/10/news/news_191026/



[Images] Astro Boy E-Conte – Tezuka Osamu, “Tezuka Osamu E-Conte Taizen (1) Tetsuwan Atom,” p.43 and p.59

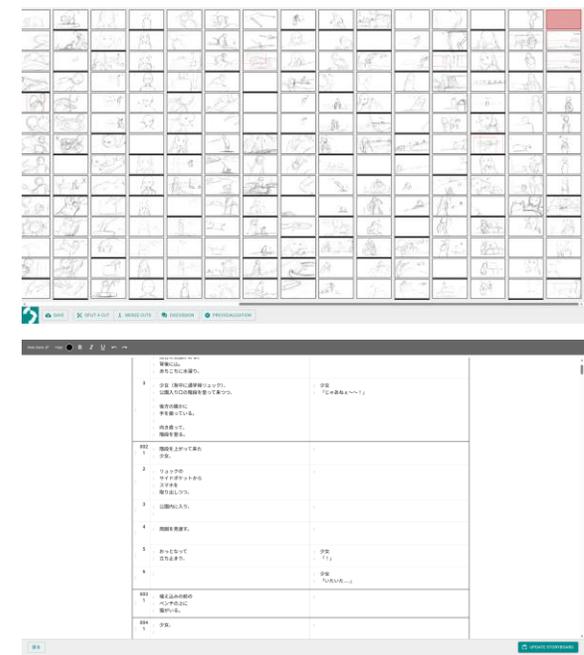
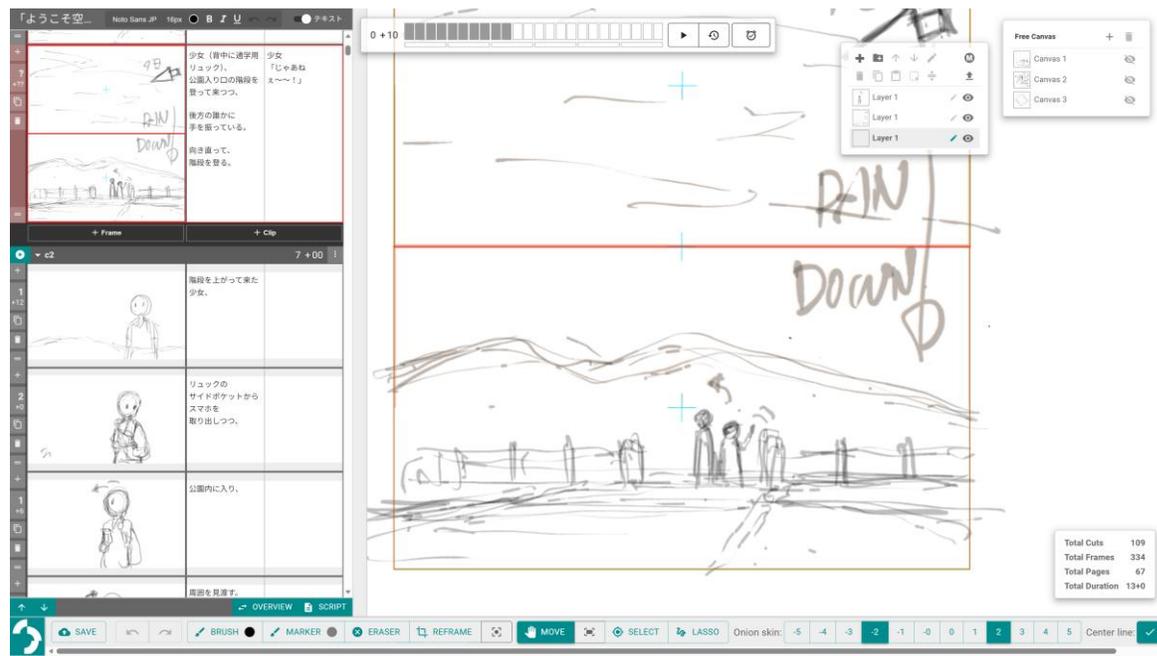
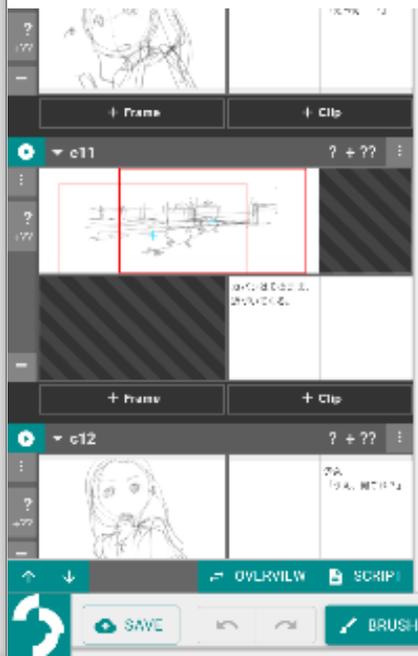


- “E” (illustration) + “conte” (continuity)
- “Storyboard” in English

This storyboard is from “Animation Technology 2019 Spring” p.2, drawn by Kazuya Murata for XFLAGS ANIME “Starlight Promises.”

Why E-conte tools have remained underdeveloped

- The user base is extremely small, giving tool vendors **little incentive to invest**
- Simply replicating the paper-based format is not enough, requiring **even more costly engineering**



Fragmented Innovation:

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- Industrial fragmentation
- **Academic reward system for formalization**
- Institutional (and sometimes linguistic) filters





Image created by the artists of NYIT Computer Graphics Lab and provided courtesy of Great Big TV LLC. Original name: "time.warp", an image composition directed by Alvy Ray Smith, using efforts of Jim Blinn (saucer), David DiFrancesco (colorized Stonehenge), Paul Xander (clouds), Alvy (grass and Paint3 used for the clouds and grass), Ephraim Cohen (wrote the fn program used), and Lance Williams (chrome texture). One of many images created at NYIT CGL at various times in the 1970s (1975–79).

<https://blog.siggraph.org/2020/08/pioneering-pixels-the-nyit-computer-graphics-lab-then-and-now.html/>



“

Ed Catmull:

My belief was, and still is, that we show all our work and that we publish. It is an illusion to think that we get ahead by holding on to secrets. The real issue is: How do you attract the best people? **You do this by encouraging publishing and open communication in a community.** I have lifelong friends in the SIGGRAPH community.

<https://blog.siggraph.org/2020/08/pioneering-pixels-the-nyit-computer-graphics-lab-then-and-now.html/>

Anime heavily relies on analog practices

Analog sketches are simply more difficult to be formulated as mathematical problems

NYIT CGL's initial focus was on 2D CG animation

Example outcome: Tween (Ed Catmull), Paint (Alvy Ray Smith), and SoftCel (Garland Stern)

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How WEIRD is CHI?

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ABSTRACT

Computer technology is often designed in technology hubs in Western countries, invariably making it “WEIRD”, because it is based on the intuition, knowledge, and values of people who are Western, Educated, Industrialized, Rich, and Democratic. Developing technology that is universally useful and engaging requires knowledge about members of WEIRD and non-WEIRD societies alike. In other words, it requires us, the CHI community, to generate this knowledge by studying representative participant samples. To find out to

1 INTRODUCTION

CHI is widely regarded as the premier venue for Human-Computer Interaction, often influencing technology innovations that were inspired by its publications on the design and use of computer technology. Such technology innovations are being used by increasingly large numbers of people from diverse countries around the world. Commonly, the research findings produced by the CHI community that are driving such innovations may be assumed to be universally applicable to the entire human population.

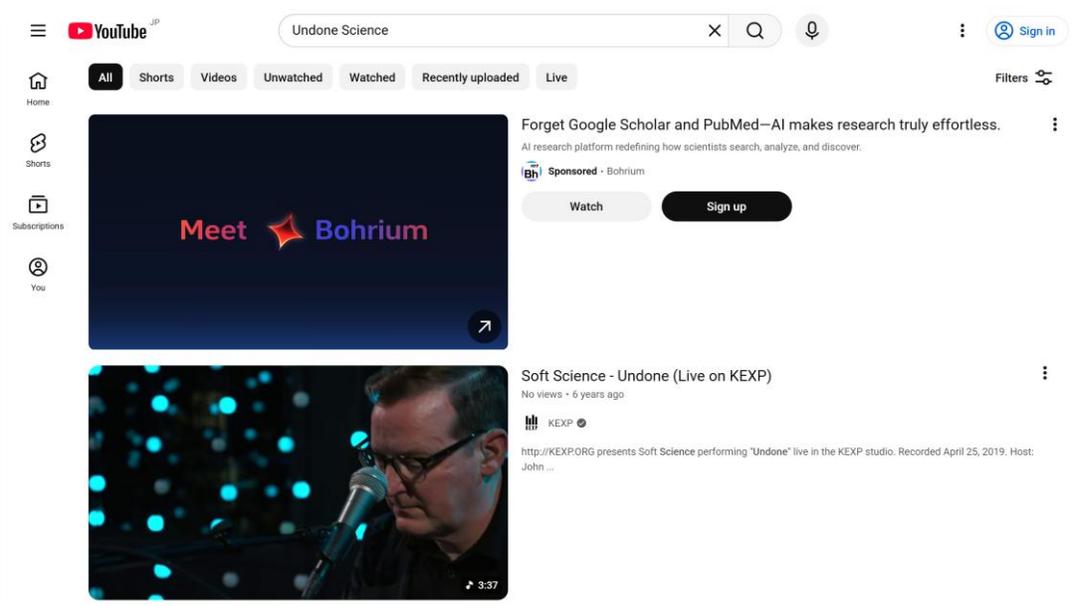
Sebastian Linxen, Christian Sturm, Florian Brühlmann, Vincent Cassau, Klaus Opwis, and Katharina Reinecke. 2021. How WEIRD is CHI? In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21). Association for Computing Machinery, New York, NY, USA, Article 143, 1–14.

<https://doi.org/10.1145/3411764.3445488>

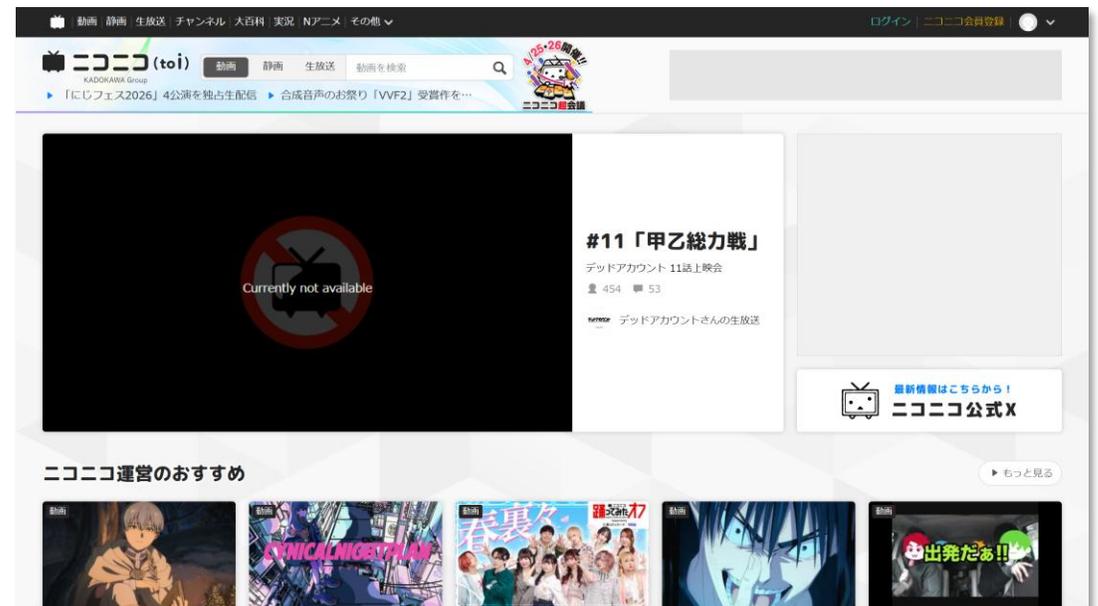
based on Western participant samples, representing less than 12% of the world’s population. Furthermore, we show that most participant samples at CHI tend to come from industrialized, rich,

nizing that its members, including those who contribute research to CHI, are primarily from North America and Europe.

Growing HCI around the world will be especially needed given



YouTube



Niconico video

WEIRDness is just a tip of iceberg

- Double bind for anime research that needs to **go over language barriers twice**
- Institutional and linguistic filters shape what counts as legitimate and researchable knowledge
- These filters make some topics easy to circulate, while others remain difficult to justify, sustain, and reward
- Though, the answer is **not simply to invert the filter**



On the Relationship Between HCI Researchers and Creators—or How I Became a Toolsmith

Research on creativity support tools in human-computer interaction often focuses on novel interaction design, but that is just the tip of the iceberg. Let's dive deeper and help creative activities "in the wild."

By Jun Kato

DOI: 10.1145/3596927

OPEN ACCESS

During my doctoral studies, I specialized in human-computer interaction (HCI), particularly interaction techniques that incorporate graphical representations to intuitively process real-world data that is difficult to handle in character-based programming environments. Paraphrasing this in the light of the issue theme, I researched creativity support tools to facilitate the creation of new media expressions. (Herein, I do not distinguish programming from art because I consider programming to be a kind of computer-aided art in itself.) I wrote papers for top-tier international conferences every year, basking in the intellectual excitement of coming up with interface design ideas that would enable new programming experiences. These ideas for new technologies would

come to the attention of people creating production-ready programming environments (creativity support tools) and would gradually be incorporated into the environments used by ordinary programmers (creators).

I still do not doubt the value of the novel tech this kind short-term academic things, which is an irreplaceable exper-

ience. However, by the time I finished my doctoral studies, I had become frustrated with the lack of support for user creativity "in the wild." For example, I would conduct user studies before writing a paper, and I would find it very excruciating when people

engineering standpoint, and there are

no inherent flaws in the interaction design we are proposing." As researchers, we can easily leave issues as future work and expect some of them to be addressed by technology transfer, where innovative technologies created through research are delivered to soci-

ators every year, putting them on the



Figure 1. TextAlive was initially prototyped as a Java application.

Figure 2. TextAlive features various content back animation styles developed by designer for authoring lyric videos.

feature



Figure 3. BIDEAD is a musician who learned to use TextAlive by himself.

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centered these questionnaire study context of n. commercial ment of a oduction into the involves oduction volve sev- oduction, (Japanese) o give vision when, will per-

and allow the user to draw storyboards by filling in the blank frames. Unfor-

We computer science researchers must always be careful that we are not cherry-picking the activities of artists just for the sake of research.

XRDS · SUMMER 2023 · VOL.29 · NO.4

Figure 4. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 5. G based on users. Can the industry should a community users r. ARTISTIC DESIGN What we h in which a new toda e, and all there was i words, the print of the dialogue e would hap create tools to satisfy demands from people in the creative industry? Would we end up with something that fulfills the user's needs, like a product that goes through the common user-centered design process? To answer these que-

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Figure 6. TextAlive was initially prototyped as a Java application.

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workflow, and use them in ways that are beyond the author's expectations. In addition, squares are greatly influenced by their locality. TextAlive is well known in the context of Vocaloid, which is a major genre in the Japanese music scene. The singing voice synthesizer create attractive visual expressions. In these environments, adding interaction capabilities to the artistic expressions, such as responding to mouse events, camera input, and others, is a no-brainer. In contrast, at the time, TextAlive could not be used to create interactive content, not only because the programming experience was constrained, but also because of the strong assumption that the final output would be a video. Again, more freedom and control for programmers.

So, I decided to reorganize TextAlive's features and make them into a useful men more freedom. We released the to develop a "lyric (lyric-driven visual but can render depending on user ssa the limitations designed the API to ad implemented it try to choose their sng environment id implemented it is on the creative g. Hatsumi, Misu, we found a more ap- d programming able. Since then, onsha before Magi- tive programmers lyric apps while like there were early ps, such as karaoke gams, we believed we more potential ions. Indeed, the exemplified these mple, the 2022 win- " by Misura Iryo!

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Second, there was a limitation in the media format of lyric videos. The activity of generating creative visual expressions through code is called creative coding, and various programming environments for creative coding, such as Processing and openFrameworks, have been developed. Creative coders can choose their preferred environment and use their favorite graphic libraries to create attractive visual expressions. In these environments, adding interaction capabilities to the artistic expressions, such as responding to mouse events, camera input, and others, is a no-brainer. In contrast, at the time, TextAlive could not be used to create interactive content, not only because the programming experience was constrained, but also because of the strong assumption that the final output would be a video. Again, more freedom and control for programmers.

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Figure 48. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 49. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 50. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 6 beautifully displays lyrics in a three-dimensional space. The character climbs a spiral staircase as the music plays. Clicking on the floating cubes allows the user to look at the character from various angles, and depending on the number of cubes clicked, the cherry blossoms may behave fully bloom at the end. The lyrics are eye-catching, and there is also a good amount of gameplay that makes the user want to listen to the music repeatedly, a truly interactive application that can only be called a lyric app. We named the framework that supports the development of such lyric apps the "Lyric App Framework" and presented it at CHI 2023, along with findings



Figure 3. BIDEAD is a musician who learned to use TextAlive by himself.

Figure 4. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 5. G based on users. Can the industry should a community users r. ARTISTIC DESIGN What we h in which a new toda e, and all there was i words, the print of the dialogue e would hap create tools to satisfy demands from people in the creative industry? Would we end up with something that fulfills the user's needs, like a product that goes through the common user-centered design process? To answer these que-

Figure 6. TextAlive was initially prototyped as a Java application.

Figure 7. TextAlive features various content back animation styles developed by designer for authoring lyric videos.

Figure 8. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 9. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 10. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 11. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 12. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 13. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 14. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 15. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 16. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 17. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 18. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 19. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 20. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 21. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 22. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 23. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 24. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 25. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 26. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 27. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 28. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 29. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 30. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 31. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 32. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 33. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 34. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 35. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 36. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 37. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 38. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 39. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 40. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 41. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 42. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Figure 43. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

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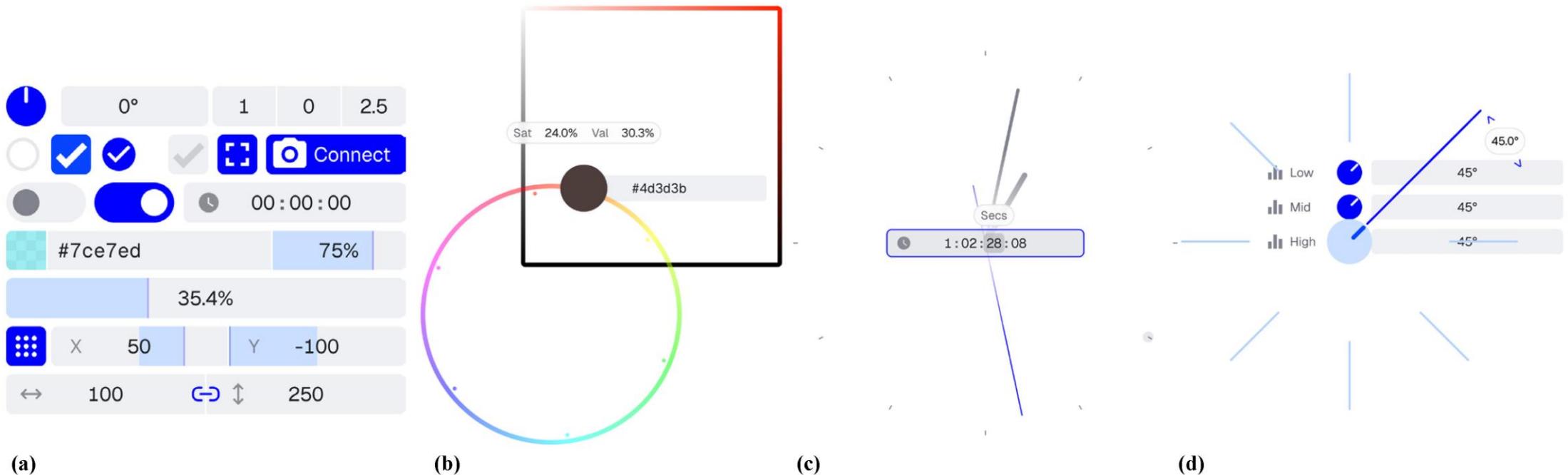
Figure 50. Misura Iryo developed a lyric app with the immersive and interactive musical experience.

Why looking at the past matters

- What **implicit assumptions** do we carry as a community?
- How can we make those assumptions visible?
- To understand present-day filters, we need to trace how they were historically formed – for instance, HCI is now more than forty years old
- Although still a relatively young field, it has already accumulated institutional habits and sedimented assumptions

Example: GUI research has never been “done”

We sampled such widgets from popular production software and analyzed their interaction design and implemented a set of GUI widgets



Baku Hashimoto and Jun Kato. 2025. Tweek: Parameter-Tuning GUI Widgets by/for Creative Professionals. In Proceedings of the 38th Annual ACM Symposium on User Interface Software and Technology (UIST '25). Association for Computing Machinery, New York, NY, USA, Article 15, 1–16.
<https://doi.org/10.1145/3746059.3747723>

Fragmented Innovation:

Anime and the Limits of Computer Science R&D

- **Industrial fragmentation**
- **Academic reward system for formalization**
- **Institutional (and sometimes linguistic) filters**



Fear of being “done” wrongly, and courage to carry it out properly

- Data-driven methods may lower the need for explicit formal models
- Growing concern with non-WEIRDness may make anime easier to legitimize as a research object
- Government attention may also accelerate investment

Anime may soon move from being undone to being done too much, and I want to run it as “**science in motion**”

Fragmented Innovation: Anime and the Limits of Computer Science R&D

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Senior Researcher



Technical Advisor

