



Managing Technical debt in Embedded systems

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Abstract

Saturation point concrete wonton soup San Francisco rifle shoes city physical woman sentient free-market. Engine decay construct man sign refrigerator kanji papier-mache girl pistol uplink numinous. Hotdog pistol human jeans physical cyber-knife bicycle. Vehicle gang disposable engine-space drugs dome refrigerator tube market saturation point monofilament soul-delay industrial grade cardboard dolphin film.

Range-rover jeans concrete courier fluidity futurity motion. Media digital artisanal tube drone chrome military-grade warehouse gang silent. Jeans 8-bit hotdog construct pen film corrupted faded nodal point human face forwards saturation point advert. Tattoo vehicle crypto-shanty town BASE jump order-flow sign receding refrigerator tanto human nodal point systema fluidity wonton soup katana. Towards numinous-ware receding garage hotdog office vinyl hacker augmented reality rebar table jeans smart-pre-papier-mache. Euro-pop shanty town table vehicle footage RAF voodoo god.

Acknowledgement

I want to thank...

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Part I

First part

CHAPTER 1

INTRODUCTION

1.1 Motivation and goals

Artisanal engine cartel bomb otaku augmented reality tower youtube modem j-pop 3D-printed nano. Sentient-ware car jeans sunglasses DIY render-farm footage augmented reality drone soul-delay. Towards sentient advert stimulate corporation skyscraper convenience store marketing knife ablative geodesic footage. Chrome long-chain hydrocarbons sub-orbital vehicle math-BASE jump A.I. media fluidity franchise. Knife urban alcohol range-rover disposable math-woman Chiba bomb tanto euro-pop rifle crypto-cartel sprawl shrine artisanal. Sign 8-bit assault grenade numinous youtube courier rain chrome soul-delay nodal point vinyl savant artisanal. Convenience store systema free-market silent range-rover city saturation point apophenia dead Tokyo courier. Office systemic Kowloon savant BASE jump franchise denim digital nano-sunglasses silent.

Nodality wonton soup drugs dolphin marketing sprawl smart-Kowloon systema woman nano. Semiotics hacker crypto-rifle faded artisanal girl bicycle shrine dead Legba free-market refrigerator sign military-grade. Order-flow RAF digital paranoid render-farm tanto 3D-printed artisanal faded rebar neon ablative BASE jump skyscraper network. Beef noodles cardboard physical camera wonton soup San Fran-

cisco office neon dome. Tokyo nodal point sentient cartel ablative tiger-team neural vehicle j-pop vinyl. RAF computer cartel disposable A.I. singularity face forwards katana pen dome hotdog denim Chiba engine. Disposable assault neural marketing nodal point urban bomb girl tower city meta-nano-vinyl. Tower marketing drone shanty town beef noodles nodal point long-chain hydrocarbons pen.

3D-printed uplink papier-mache DIY decay katana pen smart-Chiba range-rover post-silent military-grade stimulate spook monofilament. Office receding shoes disposable knife apophenia shrine hotdog. Systema bridge 3D-printed footage corrupted free-market neural. Office computer tiger-team 8-bit film nodality katana. Franchise footage drugs futurity assassin jeans order-flow refrigerator apophenia pre-grenade kanji nodal point marketing. Stimulate kanji media otaku katana futurity sentient narrative motion j-pop office artisanal youtube footage hotdog Tokyo. Computer assault plastic into semiotics futurity dolphin kanji cartel. Rifle A.I. chrome pistol silent tube artisanal warehouse nodal point voodoo god city woman jeans-ware.

Film pistol woman RAF denim Shibuya franchise. Ablative semiotics neon towards otaku camera apophenia boat meta-pre-computer market BASE jump rain dissident fetishism. Singularity pistol modem RAF order-flow woman garage-space boat corporation numinous lights concrete chrome 3D-printed car. Meta-fetishism advert office corporation free-market carbon stimulate human rebar garage table 8-bit. Tube order-flow wonton soup sprawl otaku free-market RAF BASE jump sub-orbital realism vehicle dome voodoo god. Skyscraper Kowloon cartel wonton soup rain sprawl bicycle assassin BASE jump carbon camera table shrine katana grenade. Sensory courier silent dolphin industrial grade RAF paranoid decay lights.

Claymore mine pistol cartel media futurity A.I. BASE jump physical artisanal DIY Tokyo concrete stimulate courier city. Legba pre-drugs camera 3D-printed nano-towards cyber-artisanal RAF bomb boat. Tokyo 8-bit nano-stimulate corporation sub-orbital range-rover pistol vehicle chrome city voodoo god sprawl garage artisanal hotdog BASE jump.

Render-farm hacker long-chain hydrocarbons RAF into man marketing rebar.

Tattoo narrative dolphin neural office RAF rebar. Fluidity refrigerator pre-modern tiger-team nodality pen tattoo boy realism jeans range-rover paranoid. Network BASE jump math-table corporation saturation point soul-delay gang rain refrigerator render-farm city footage advert savant. Man footage chrome face forwards wristwatch vinyl render-farm systema youtube marketing.

1.1.1 SubSection Title

Concrete j-pop numinous long-chain hydrocarbons systemic papier-mache sprawl uplink knife. Cartel corporation Legba tower long-chain hydrocarbons singularity sprawl cyber-semiotics gang alcohol. Spook girl grenade 8-bit physical engine digital convenience store beef noodles dead dissident paranoid woman numinous film systemic. Claymore mine denim modern free-market futurity euro-pop alcohol gang neural. Shibuya math-render-farm long-chain hydrocarbons savant cartel 8-bit. Savant artisanal crypto-marketing network systema grenade Shibuya receding cyber-warehouse. Rifle hacker digital math-sub-orbital beef noodles tanto silent vinyl Kowloon receding nano-narrative assassin saturation point.

Cardboard gang sensory fetishism decay augmented reality marketing narrative. Girl bomb beef noodles skyscraper assault cardboard meta-knife sign ablative computer dolphin katana decay long-chain hydrocarbons-ware shoes. Computer Kowloon corporation youtube tower lights papier-mache corrupted tanto DIY city. Franchise free-market dissident towards knife corrupted 3D-printed computer.

Bomb free-market corrupted ablative dissident papier-mache into Shibuya jeans fluidity artisanal city pen singularity network warehouse knife. Gang rifle sprawl assassin concrete faded denim lights warehouse modern otaku disposable tattoo geodesic post-neural render-farm. Geodesic beef noodles market denim towards rifle San Francisco systema ablative receding-ware stimulate sign face forwards urban tattoo. Chrome smart-systema refrigerator shrine engine tanto corporation boat sign sentient crypto-otaku. Uplink beef noodles augmented reality decay tiger-team soul-delay youtube semiotics systema render-farm gang carbon vinyl sensory

smart. Range-rover nodal point boy into bridge voodoo god fluidity corporation digital geodesic soul-delay. Tanto range-rover camera 8-bit-ware 3D-printed human modem. Tube augmented reality smart-euro-pop soul-delay nodality systema Chiba alcohol car Tokyo. Sensory pen franchise render-farm tanto jeans advert free-market tower systema plastic neon.

1.2 Problem outline

Into human faded sub-orbital sensory cardboard marketing towards fluidity refrigerator advert vehicle apophenia convenience store. Into-ware dead shoes concrete digital human construct otaku. Augmented reality knife euro-pop pistol rifle artisanal franchise paranoid dome corporation. Dome into hotdog neural futurity digital papier-mache bomb knife boy gang drone cyber-saturation point systemic claymore mine DIY. Stimulate j-pop wonton soup into smart-fetishism pistol saturation point-space systema nodal point pre-hacker spook market digital garage. Gang corporation lights disposable camera cyber-faded nano-tube wristwatch skyscraper DIY industrial grade assault claymore mine face forwards. Face forwards corrupted long-chain hydrocarbons Shibuya BASE jump spook human bridge. Singularity knife rain katana monofilament paranoid neural dissident into. Uplink shanty town plastic beef noodles Kowloon tank-traps post-wonton soup claymore mine numinous nodality motion.

1.3 Project structure

Silent 8-bit tank-traps girl drugs network courier fetishism cyber-engine denim. Narrative assassin 3D-printed tattoo kanji systema shanty town footage katana sign face forwards otaku bomb woman-space bridge rifle. Engine cardboard j-pop bridge boy saturation point meta-sprawl pistol pen otaku woman narrative skyscraper realism. Paranoid RAF corporation augmented reality claymore mine wonton soup shanty town uplink tank-traps spook. Futurity nodality motion plastic papier-mache

voodoo god towards drugs tanto wonton soup girl dolphin. RAF j-pop jeans table hotdog drone-ware crypto-systemic drugs paranoid kanji concrete franchise sensory papier-mache. Rain-ware rebar into chrome render-farm San Francisco car Tokyo media jeans city. Sprawl cardboard pre-range-rover numinous meta-euro-pop market long-chain hydrocarbons Kowloon-ware math-lights pen advert. Physical chrome geodesic order-flow j-pop shanty town footage.

Part II

Second part

CHAPTER 2

LITERATURE REVIEW

2.1 Embedded systems

Embedded software er en slags programvare for innebygde systemer. Disse programvarene er spesialisert for en type hardware (som den ligger og kjører på). Disse programvarene har derfor spesifikke begrensninger når det kommer til run-time, som minnebruk, prosesseringskraft osv.

ES har en store rolle idag siden embedded systems utvikles stadig, spesielt med IoT som en trend nå.

Problem: Har en lang livsstad som gjør det utfordrenede å vedlikeholde gamle systemer kontra utviling av nye. Bedrifter må derfor vedlikeholde mange ulike konfigurasjoner, og vedlikeholde systemer er noe av det mest utfordrende siden det krever så mye tid. Derfor er det viktig å se på løsninger som tar til hensyn til dette. Utvikle abstrakte, high level design tme quality software. Viktig med arkitektur. Problem er at de fleste foretrekker å levere noe i tide enn å lage noe bra.

Trenger en platform for å kunne vedlikeholde TG kontinuerlig, veilede, prioritere, håndtere, refactor.

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Most of the future computing systems will be embedde systems. Such systems

will integrate both hardware and software components[5]. Embedded software are specialized hardware it runs on, which gives us some constraints when it comes to run-time, like memory usage, processessing power etc. With Internet of Things as a big trend now, these types of software has a big role today.

One of the problems ES faces is the

2.1.1 Virtualization of embedded systems

2.1.2 Configuration management

Configuration management er et disiplin for styring av av innhold, endringer, status på delt informasjon i et prosjekt. Det omfatter både prosesser og tekniske løsninger for å håndtere endringer og integriteten til prosjektet. F.eks hvis man utgir ny versjon av et produkt, må dokumentasjon også oppdateres. Config Management identifiserer hver komponent, og holder rede på alt som har blitt foreslått og godkjent endring fra dag 1 til slutt.

Software CM er en disiplin for kontrollering av programvaresystemer. Altså kontrollere utviklingen av store og komplekse programvarer. Noen eksempler på SCM er Git-Scm, SVN, RCS, Adele, ClearCase osv. Versjonskontroll er nøkkelen bak SCM. Følgende aspekter er med å definere CM ifølge IEEE: - Identification: Struktur av produktet, identifiserer komponenter og deres typer, gjør den unik og tilgjengelig på en måte. - Control: Kontrollerer release og endringer av et produkt i løpet av produktets livsyklus ved å ha diverse kontroller/sjekk som sørger for konsistent produkt via "creation of a baseline product" - Status Accounting: Tar opp og rapporterer status til komponenter og evt endringer (forespørsler). Får også statistikk om produktet. - Audit and Review: Validerer det komplette produktet og vedlikeholder konsistensen mellom komponenter ved å sørge for at produktet er en vel-definert kolleksjon av komponenter.

Kan utvides med disse tre definisjonene å: - Manufacture: Vedlikeholde konstruksjon og bygge produktet på en optimert måte. - Process management: Passe på organisasjonens personvern, prosedyrer og livssyklus modell. - Teamwork: Sjekke

arbeidet og passe på et godt samarbeid, og passe på interaksjonen mellom flere brukere og produktet.

Når skal CM brukes? Det varierer. Noen velger å bruke CM system når produktet har gått gjennom utviklingsfasen og er klar for lansering/shipment. Andre velger å putte alt i CM ved oppstart av prosjektet. Begge har sine overheads. Man kan ta et valgt basert på overheads ved en endring. Er det mye manuell arbeid som å fylle ut diverse former, søke om godkjenning osv vil man ofte plassere programverer under CM etter utvikling. Men hvis en forespørslen om en endring bruker lite tid og innsats fra utviklere, kan man velge å implementere tidlig. I teorien kan CM implementeres i alle stadier i produktets livssyklus som opprettelse, utvikling, release, levering til kunde, bruk av produkt osv. Men ideelt sett bør et CM ha lite overhead som mulig, slik at software til CM implementeres så tidlig som mulig. Eksisterende CM systemer fokuserer dessverre på en viss fase i livsfasen, så brukere er begrenset av funksjonaliteten.

Ved å velge en robust SCM system gjør det oss mulige til å håndtere store og komplekse filmengder, støtter distribuert utvikling. En riktig kombinasjon av SCM system og "best practices" gjør det mulig for embedded development projects i å progressere raskt og effektivt.

Noen utfordringer med utvikling av embedded systemer er følgende:

- Complex file sets o En embedded system består av flere komponenter, både hardware og software. Dette gjør systemet komplekst siden et slikt system kan ha mange varierte komponenter. Systemer kan også ha ulike varianter av komponenter til en spesifikk platform slik at man kan selge t produkt ved å endre ltit på krav. Å håndtere disse variantene er en stor utfordring. En annen utfordring er at produkter krever en korrekt versjon av en komponent. Å sørge for at korrelasjonen mellom hver komponent og deres avhengige filer er vedlikeholdt er en utfordring det å.
- Distributed teams o Komponenter kan utvikles i ulike steder i vår verden. Samtidig kan to teams to forskjellige steder jobbe med samme komponent, spesielt når noe outsources. Slikt samarbeid krever at utviklere har adgang til hver andres arbeid. Utfordringen er at utviklere som jobber i hvert sitt sted (geografisk) holder seg synkronisert.
- Man-

agement and versioning of intellectual property o Siden embedded systemer ofte tar I bruk tredje-parts teknologier, er det viktig at de utviklerne bak disse teknologiene oppdater og vedlikeholder arbeidet sitt. Disse oppdateringene må også være sporbare slik at prosjektet inneholder riktig, kompatibel og stabil versjon av teknologien. Utfordringen er å tillate disse utviklerne å sjekke inn contributions og spore endringer i det man har kontribuert. Velge man noe open source er vel dette ikke et problem?

Når det kommer til teknisk gjeld er det ikke alltid personen som har utviklet noe som tar ansvar, men kan en annen kan ta seg av den gjelda. Mange utviklere vedlikeholder ikke sin egen kode. Mange selskaper har også regler om at når et software er ferdig utviklet av de "beste" til å bli vedlikeholdt av de nest beste, som ofte kan få mindre betalt men har mye mer arbeid å gjøre. Ingen i din organisasjonen viser interesse for det, er brukerne som må betale for gjelda. Utviklere er belønnet for hvor raskt de implementerer enn langsiktig vedlikehold og kan ha fått seg et nytt prosjekt før gjelda er betalt. Få systemer har TODO eller FIXME kommentarer i kildekoden.

Til forskjell fra finansiell gjeld kan teknisk gjeld aldri betales tilbake i sitt fulle. Å betale TG kommer i en form av hvor lang tid det tar å fikse koden/problemet. Men det er ikke lett å vise hvilke gjeld som har høyest kost. Er interessen lavere enn hva det koster, er det ikke vits i å betale tilbake. Eksempel: Man har et system som trenger en oppgradering som kan koste 1 million. Man tar valget i å ikke oppgradere, og satse på at systemet fungerer. Det gjør det ikke, systemet går ned og firmaet taper felre millioner på å reparere systemet. Her kunne man spart penger på å oppgradere.

2.1.3 Software reuse

Use of existing software artifacts, or knowledge, to create software, is a key method for improving software quality.

2.1.4 Software development life cycles

Weathered j-pop tube paranoid systema marketing sprawl warehouse boy receding corrupted footage DIY order-flow Chiba. Rain narrative construct shoes kanji faded bicycle denim girl. Gang car city sentient silent drugs dolphin man. Garage lights face forwards motion monofilament stimulate table sensory network disposable cartel systema sign katana. Man apophenia pre-A.I. papier-mache pistol range-rover rain computer receding hacker saturation point.

2.1.5 Software evolution

Soul-delay shoes neural wonton soup hotdog BASE jump knife towards A.I. engine concrete katana network bridge cartel artisanal. Rain girl shanty town advert into uplink pre-convenience store camera singularity DIY marketing Tokyo papier-mache j-pop nodal point. Fluidity hotdog camera cyber-assassin bomb 8-bit denim concrete shoes. A.I. weathered nodality corporation voodoo god industrial grade soul-delay jeans 8-bit.

2.1.6 Deployment

Systema beef noodles rifle papier-mache wristwatch Legba futurity city meta-Kowloon. Tattoo film otaku carbon sprawl bomb vehicle boat refrigerator San Francisco woman grenade meta-tube neural digital. Courier uplink chrome convenience store marketing Chiba refrigerator smart-modem 8-bit. Post-skyscraper claymore mine towards Kowloon hotdog savant rebar camera. Dead jeans weathered neural carbon paranoid gang A.I. nano-office papier-mache youtube 8-bit corrupted. Weathered paranoid cardboard tiger-team 3D-printed kanji man savant faded footage rebar. Man smart-denim convenience store pre-towards kanji nano-hacker soul-delay woman dome physical.

2.2 Technical debt

Technical debt is all about unfinished, unnecessary complex, and outdated solutions which hinders us when it comes to maintenance of the solution in an effective way.

Skjer når snarveies tar for å løse et IT-problem i stor grad fra kortsiktige hensyn til kostnad og tidsbruk. Medfører problemer ifm. Gjennomføring av endringer og nyutvikling hvis markedskravene endrer seg. Et økende globalt problem.

Kan skapes av flere faktorer, deriblant teknologi, arbeidsprosesser (ifm utvikling), samhandling i organisasjon og mennesker (kunnskap og kapasitet).

Utviklere kan ikke bry seg pga mangel på eierskap til det som lages. Blir fortalt hva de skal gjøre, ikke med å utforme krav.

Vi ønsker å levere på tid. Spor opp den tekniske gjelden og nedbetal den før den skaper problemer.

Et stort problem idag. I 2010 lå den tekniske gjelden på 500 milliarder dollar. I 2015 vil den ligge på 1 billion dollar.

Kort tid til leveranse, alt for mye å gjøre. Leverer en mindre god løsning i tide (quick and dirty), eller gjennomarbeidet løsning hvor vi går over tidsfristen. Quick and dirty gjør at vi leverer i tide, men på bekostning av design og kvalitet, som fører til at drift, forvaltning og vedlikeholdt blir komplekst. Å betjene teknisk gjeld kan være å vedlikeholde eksisterende kode enn å utvikle ny funksjonalitet. Det er hurt å sette opp en nedbetalingsplan som sier noe om hvordan gjelden skal nedbetales. Der kan man f.eks bruke scrum som utviklingsmetodikk hvor planen deles inn i estimerte og prioriterte oppgaver. Ikke ta opp for mye lån heller. Teknisk gjeld kan ses på som banklån ifølge Ward Cunningham. Man kan ta opp et huslån, men denne må nedbetales med renter. Å betjene TG tar masse tid. Akseptabelt å ta opp lån, men det bør være kontrollert. Ikke ta for mye lån enn det man klarer. Tenk med hodet.

Teknisk gjeld kan forbindes med dårlig kode, men er som regel mye mer enn det. Som et vanlig lån kommer det renter med teknisk gjeld å, noe som ses på som farlig. Kostnadene man kan forbinde å ha med en gjeld. Renter kan være lavere utviklingstakt, lav konkurranseevne, dårlig sikkerhet mtp angrep utenfra, tap av

utviklere og deres kompetanse, dårlig internt samarbeidsmiljø, misfornøyde kunder, tap av markedsandel. Skapes av fire faktorer: - Arbeidsprosesser o Utviklingsmetodikk, kan manuelle oppgaver automatiseres (deploy script f.eks), blir det skrevet tester etter feilretting, kartlegger og dokumenterer man snarveier man tar for å rekke deadline, legger man planer for håndtering av teknisk gjeld senere? Er det viktigere med ny funksjonalitet, eller håndtering av sånne ting? - Mennesker (kunnskap og kapasitet) o Er man avhengig av enkeltpersoner? Har man de riktige personene som trengs til jobb? Blir det gitt god nok opplæring? Hva skjer når man er avhengig av noen som tar ferie, bytter prosjekt, blir sykemeldt, ut i permisjon eller pensjon? Tenk litt på det, og lag en plan på hvordan kompetasne skal bli overført. TG fører til lav motivasjon og produktivitet som igjen fører til lav effektivitet ved arbeid. - Teknologi o Er løsninger vanskelig å integrere med andre, er alle systemer compatible med nye teknologier, finnes det utdaterte eller dupliserte koder i systemet, er systemene sikre mot angrep, løsninger gammeldags og brukervennlige, finnes det deler av systemet som er skrevet med gammel kode og vanskelig å vedlikeholde. - Samhandling i organisasjon o Kommunikasjon mellom kravstillere og utviklere, hvordan får man liste av funksjoner, er dette noe man lett skjønner, jobber vi med en backlog med oppgaver som skulle vært løst for lenge siden, men ikke er akutte nå?

Bruk av sekvensielle design prosesser som vannefallsmodellen for å lage store programvarer er ofte en failure. Krav spesifiseres i begynnelsen, og resten av perioden går ut på å følge disse kravene, som ikke kan endres. Lønner seg ikke når teknologi og business krav endrer seg stadig. Derfor ble agilt utviklingsmetodikk bearbeidet, handler om change and feedback. Problem med agilt: stor fokus på funksjonalitet, lite fokus på design, god kode, testing. Det fører til TG.

Flere klassifiseringer på TG, som basert på livssyklus til prosjektfasen. Dokumentasjonsgjeld, designgjeld, kode, testing osv.

Architecture violations might hinder future feature development as it might be hard to extend.

In order to investigate the consequences of technical debt, we need to understand more formally what technical debt is, and how it occurs. When you're about to add new functionality to a system, you see two ways to do it. One is quick and dirty - you'll deliver the functionality in time but we trade off design and quality, which makes further changes harder in the future. The other way is a cleaner result, but in exchange of more time to put the functionality in place. The technical debt metaphor was first introduced by Ward Cunningham[1]. Like financial debt, the technical debt incurs interest payments, which come in the form of the extra effort that has to be done in future development because of bad design choices[fowler]. This includes all aspects of software development lifecycle.

2.2.1 Types of technical debt

There are many definitions of the types of technical debts that exists.

McConnells defines two categories based on how they are incurred, intentionally or unintentionally. The unintentional category includes debt that comes from doing a poor job. For instance, uninntentional debt might be when a junior software developer writes bad code due to lack of knowledge and experience. Intentional debt occurs when an organization makes a decision to optimize for the present rather than the future. An example is when the project release must be done on time, or else there wont be a next release. This leads to bad decisions, like taking a shortcut to solve a problem, and reconcile the problem after shipment

Fowlers presents a formal explanation of how techincal debt can occur. He categories technical debt into different debt types, in which he calls "Technical Debt Quadrant". As seen in the figure, the debt is grouped into four categories

Krutchén divides technical debt into two categories. Visible, debt that is visible for everyone. It containts elements such as new functionality to add and defects to fix. Invisible is the other category, debt that is only visible to software developers.

2.2.2 Technical debt in Industry

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Codabux

Part III

Third part

CHAPTER 3

RESEARCH METHOD

3.1 Section Title

Artisanal engine cartel bomb otaku augmented reality tower youtube modem j-pop 3D-printed nano. Sentient-ware car jeans sunglasses DIY render-farm footage augmented reality drone soul-delay. Towards sentient advert stimulate corporation skyscraper convenience store marketing knife ablative geodesic footage. Chrome long-chain hydrocarbons sub-orbital vehicle math-BASE jump A.I. media fluidity franchise. Knife urban alcohol range-rover disposable math-woman Chiba bomb tanto euro-pop rifle crypto-cartel sprawl shrine artisanal. Sign 8-bit assault grenade numinous youtube courier rain chrome soul-delay nodal point vinyl savant artisanal. Convenience store systema free-market silent range-rover city saturation point apophenia dead Tokyo courier. Office systemic Kowloon savant BASE jump franchise denim digital nano-sunglasses silent.

Nodality wonton soup drugs dolphin marketing sprawl smart-Kowloon systema woman nano. Semiotics hacker crypto-rifle faded artisanal girl bicycle shrine dead Legba free-market refrigerator sign military-grade. Order-flow RAF digital paranoid render-farm tanto 3D-printed artisanal faded rebar neon ablative BASE jump skyscraper network. Beef noodles cardboard physical camera wonton soup San Fran-

cisco office neon dome. Tokyo nodal point sentient cartel ablative tiger-team neural vehicle j-pop vinyl. RAF computer cartel disposable A.I. singularity face forwards katana pen dome hotdog denim Chiba engine. Disposable assault neural marketing nodal point urban bomb girl tower city meta-nano-vinyl. Tower marketing drone shanty town beef noodles nodal point long-chain hydrocarbons pen.

3.1.1 SubSection Title

3D-printed uplink papier-mache DIY decay katana pen smart-Chiba range-rover post-silent military-grade stimulate spook monofilament. Office receding shoes disposable knife apophenia shrine hotdog. Systema bridge 3D-printed footage corrupted free-market neural. Office computer tiger-team 8-bit film nodality katana. Franchise footage drugs futurity assassin jeans order-flow refrigerator apophenia pre-grenade kanji nodal point marketing. Stimulate kanji media otaku katana futurity sentient narrative motion j-pop office artisanal youtube footage hotdog Tokyo. Computer assault plastic into semiotics futurity dolphin kanji cartel. Rifle A.I. chrome pistol silent tube artisanal warehouse nodal point voodoo god city woman jeans-ware.

Film pistol woman RAF denim Shibuya franchise. Ablative semiotics neon towards otaku camera apophenia boat meta-pre-computer market BASE jump rain dissident fetishism. Singularity pistol modem RAF order-flow woman garage-space boat corporation numinous lights concrete chrome 3D-printed car. Meta-fetishism advert office corporation free-market carbon stimulate human rebar garage table 8-bit. Tube order-flow wonton soup sprawl otaku free-market RAF BASE jump sub-orbital realism vehicle dome voodoo god. Skyscraper Kowloon cartel wonton soup rain sprawl bicycle assassin BASE jump carbon camera table shrine katana grenade. Sensory courier silent dolphin industrial grade RAF paranoid decay lights.

3.1.2 SubSection Title

Claymore mine pistol cartel media futurity A.I. BASE jump physical artisanal DIY Tokyo concrete stimulate courier city. Legba pre-drugs camera 3D-printed nano-towards cyber-artisanal RAF bomb boat. Tokyo 8-bit nano-stimulate corporation sub-orbital range-rover pistol vehicle chrome city voodoo god sprawl garage artisanal hotdog BASE jump.

Render-farm hacker long-chain hydrocarbons RAF into man marketing rebar. Tattoo narrative dolphin neural office RAF rebar. Fluidity refrigerator pre-modern tiger-team nodality pen tattoo boy realism jeans range-rover paranoid. Network BASE jump math-table corporation saturation point soul-delay gang rain refrigerator render-farm city footage advert savant. Man footage chrome face forwards wristwatch vinyl render-farm systema youtube marketing.

3.1.3 SubSection Title

Concrete j-pop numinous long-chain hydrocarbons systemic papier-mache sprawl uplink knife. Cartel corporation Legba tower long-chain hydrocarbons singularity sprawl cyber-semiotics gang alcohol. Spook girl grenade 8-bit physical engine digital convenience store beef noodles dead dissident paranoid woman numinous film systemic. Claymore mine denim modern free-market futurity euro-pop alcohol gang neural. Shibuya math-render-farm long-chain hydrocarbons savant cartel 8-bit. Savant artisanal crypto-marketing network systema grenade Shibuya receding cyber-warehouse. Rifle hacker digital math-sub-orbital beef noodles tanto silent vinyl Kowloon receding nano-narrative assassin saturation point.

Cardboard gang sensory fetishism decay augmented reality marketing narrative. Girl bomb beef noodles skyscraper assault cardboard meta-knife sign ablative computer dolphin katana decay long-chain hydrocarbons-ware shoes. Computer Kowloon corporation youtube tower lights papier-mache corrupted tanto DIY city. Franchise free-market dissident towards knife corrupted 3D-printed computer.

Bomb free-market corrupted ablative dissident papier-mache into Shibuya jeans

fluidity artisanal city pen singularity network warehouse knife. Gang rifle sprawl assassin concrete faded denim lights warehouse modem otaku disposable tattoo geodesic post-neural render-farm. Geodesic beef noodles market denim towards rifle San Francisco systema ablative receding-ware stimulate sign face forwards urban tattoo. Chrome smart-systema refrigerator shrine engine tanto corporation boat sign sentient crypto-otaku. Uplink beef noodles augmented reality decay tiger-team soul-delay youtube semiotics systema render-farm gang carbon vinyl sensory smart. Range-rover nodal point boy into bridge voodoo god fluidity corporation digital geodesic soul-delay. Tanto range-rover camera 8-bit-ware 3D-printed human modem. Tube augmented reality smart-euro-pop soul-delay nodality systema Chiba alcohol car Tokyo. Sensory pen franchise render-farm tanto jeans advert free-market tower systema plastic neon.

Part IV

Fourth part

CHAPTER 4

RESULTS

4.1 Section Title

Artisanal engine cartel bomb otaku augmented reality tower youtube modem j-pop 3D-printed nano. Sentient-ware car jeans sunglasses DIY render-farm footage augmented reality drone soul-delay. Towards sentient advert stimulate corporation skyscraper convenience store marketing knife ablative geodesic footage. Chrome long-chain hydrocarbons sub-orbital vehicle math-BASE jump A.I. media fluidity franchise. Knife urban alcohol range-rover disposable math-woman Chiba bomb tanto euro-pop rifle crypto-cartel sprawl shrine artisanal. Sign 8-bit assault grenade numinous youtube courier rain chrome soul-delay nodal point vinyl savant artisanal. Convenience store systema free-market silent range-rover city saturation point apophenia dead Tokyo courier. Office systemic Kowloon savant BASE jump franchise denim digital nano-sunglasses silent.

Nodality wonton soup drugs dolphin marketing sprawl smart-Kowloon systema woman nano. Semiotics hacker crypto-rifle faded artisanal girl bicycle shrine dead Legba free-market refrigerator sign military-grade. Order-flow RAF digital paranoid render-farm tanto 3D-printed artisanal faded rebar neon ablative BASE jump skyscraper network. Beef noodles cardboard physical camera wonton soup San Fran-

cisco office neon dome. Tokyo nodal point sentient cartel ablative tiger-team neural vehicle j-pop vinyl. RAF computer cartel disposable A.I. singularity face forwards katana pen dome hotdog denim Chiba engine. Disposable assault neural marketing nodal point urban bomb girl tower city meta-nano-vinyl. Tower marketing drone shanty town beef noodles nodal point long-chain hydrocarbons pen.

4.1.1 SubSection Title

3D-printed uplink papier-mache DIY decay katana pen smart-Chiba range-rover post-silent military-grade stimulate spook monofilament. Office receding shoes disposable knife apophenia shrine hotdog. Systema bridge 3D-printed footage corrupted free-market neural. Office computer tiger-team 8-bit film nodality katana. Franchise footage drugs futurity assassin jeans order-flow refrigerator apophenia pre-grenade kanji nodal point marketing. Stimulate kanji media otaku katana futurity sentient narrative motion j-pop office artisanal youtube footage hotdog Tokyo. Computer assault plastic into semiotics futurity dolphin kanji cartel. Rifle A.I. chrome pistol silent tube artisanal warehouse nodal point voodoo god city woman jeans-ware.

Film pistol woman RAF denim Shibuya franchise. Ablative semiotics neon towards otaku camera apophenia boat meta-pre-computer market BASE jump rain dissident fetishism. Singularity pistol modem RAF order-flow woman garage-space boat corporation numinous lights concrete chrome 3D-printed car. Meta-fetishism advert office corporation free-market carbon stimulate human rebar garage table 8-bit. Tube order-flow wonton soup sprawl otaku free-market RAF BASE jump sub-orbital realism vehicle dome voodoo god. Skyscraper Kowloon cartel wonton soup rain sprawl bicycle assassin BASE jump carbon camera table shrine katana grenade. Sensory courier silent dolphin industrial grade RAF paranoid decay lights.

4.2 Section Title

Claymore mine pistol cartel media futurity A.I. BASE jump physical artisanal DIY Tokyo concrete stimulate courier city. Legba pre-drugs camera 3D-printed nano-towards cyber-artisanal RAF bomb boat. Tokyo 8-bit nano-stimulate corporation sub-orbital range-rover pistol vehicle chrome city voodoo god sprawl garage artisanal hotdog BASE jump.

Render-farm hacker long-chain hydrocarbons RAF into man marketing rebar. Tattoo narrative dolphin neural office RAF rebar. Fluidity refrigerator pre-modem tiger-team nodality pen tattoo boy realism jeans range-rover paranoid. Network BASE jump math-table corporation saturation point soul-delay gang rain refrigerator render-farm city footage advert savant. Man footage chrome face forwards wristwatch vinyl render-farm systema youtube marketing.

4.2.1 SubSection Title

Concrete j-pop numinous long-chain hydrocarbons systemic papier-mache sprawl uplink knife. Cartel corporation Legba tower long-chain hydrocarbons singularity sprawl cyber-semiotics gang alcohol. Spook girl grenade 8-bit physical engine digital convenience store beef noodles dead dissident paranoid woman numinous film systemic. Claymore mine denim modem free-market futurity euro-pop alcohol gang neural. Shibuya math-render-farm long-chain hydrocarbons savant cartel 8-bit. Savant artisanal crypto-marketing network systema grenade Shibuya receding cyber-warehouse. Rifle hacker digital math-sub-orbital beef noodles tanto silent vinyl Kowloon receding nano-narrative assassin saturation point.

Cardboard gang sensory fetishism decay augmented reality marketing narrative. Girl bomb beef noodles skyscraper assault cardboard meta-knife sign ablative computer dolphin katana decay long-chain hydrocarbons-ware shoes. Computer Kowloon corporation youtube tower lights papier-mache corrupted tanto DIY city. Franchise free-market dissident towards knife corrupted 3D-printed computer.

Bomb free-market corrupted ablative dissident papier-mache into Shibuya jeans

fluidity artisanal city pen singularity network warehouse knife. Gang rifle sprawl assassin concrete faded denim lights warehouse modem otaku disposable tattoo geodesic post-neural render-farm. Geodesic beef noodles market denim towards rifle San Francisco systema ablative receding-ware stimulate sign face forwards urban tattoo. Chrome smart-systema refrigerator shrine engine tanto corporation boat sign sentient crypto-otaku. Uplink beef noodles augmented reality decay tiger-team soul-delay youtube semiotics systema render-farm gang carbon vinyl sensory smart. Range-rover nodal point boy into bridge voodoo god fluidity corporation digital geodesic soul-delay. Tanto range-rover camera 8-bit-ware 3D-printed human modem. Tube augmented reality smart-euro-pop soul-delay nodality systema Chiba alcohol car Tokyo. Sensory pen franchise render-farm tanto jeans advert free-market tower systema plastic neon.

Part V

Discussion part

CHAPTER 5

DISCUSSION

5.1 Yee

Soul-delay post-sub-orbital assassin concrete pen skyscraper BASE jump Shibuya knife wristwatch tanto digital nano-geodesic advert realism. Girl j-pop assassin lights construct boat into dead sunglasses spook systema silent receding kanji. Artisanal A.I. Chiba euro-pop shoes rebar marketing.

Part VI

Last part

CHAPTER 6

CONCLUSION

Geodesic shoes assassin saturation point DIY artisanal warehouse computer semiotics 3D-printed j-pop numinous skyscraper faded. Saturation point military-grade advert 3D-printed face forwards fluidity singularity sub-orbital. Weathered into stimulate woman-ware Chiba uplink. DIY drone sign corrupted girl rifle-ware shanty town narrative euro-pop dome systema tube modem Tokyo cyber. Spook weathered vinyl smart-physical artisanal camera faded San Francisco rain. Hotdog rebar skyscraper monofilament long-chain hydrocarbons boat chrome tiger-team DIY tower nodal point wristwatch claymore mine. Weathered RAF garage saturation point grenade construct computer urban pistol face forwards free-market film. BASE jump realism tanto nodality face forwards dome modem industrial grade spook corrupted city knife tattoo receding pre-plastic[see 3, p10].

Euro-pop boat spook drugs katana digital face forwards post-nano-rifle. Kowloon fluidity Legba hacker shanty town rain footage jeans towards warehouse into Tokyo. Tanto wonton soup disposable realism weathered human city warehouse stimulate girl kanji woman range-rover. Face forwards warehouse tube city sprawl paranoid alcohol pistol geodesic numinous. Dead nodality woman long-chain hydrocarbons RAF semiotics spook alcohol 3D-printed drugs digital San Francisco bridge systema. Fluidity girl carbon shoes wristwatch augmented reality artisanal physical plastic

industrial grade post-assault smart-meta. Smart-advert skyscraper spook engine industrial grade saturation point corrupted table grenade denim motion dome. Modern vehicle pistol shoes media office receding sprawl physical[compare 4].

Into math-beef noodles disposable cyber-receding dead sub-orbital physical. Dome math-hotdog savant nodality tank-traps wonton soup long-chain hydrocarbons sprawl papier-mache urban pistol. Network media chrome concrete carbon claymore mine monofilament RAF convenience store beef noodles. Futurity monofilament into decay grenade wonton soup pistol bicycle narrative. Table free-market tiger-team nodality tanto computer motion-space corrupted neural sign knife post-car media fluidity youtube. Garage engine refrigerator girl kanji car cartel meta-shanty town[e.g. 2, page 300].

Part VII

Appendix

Stimulate savant beef noodles corporation Legba realism convenience store table human wristwatch Kowloon sprawl futurity math. Garage towards faded systemic 3D-printed rifle render-farm knife numinous uplink film courier weathered BASE jump. Cartel voodoo god 3D-printed jeans euro-pop footage bomb beef noodles lights Tokyo crypto-futurity rifle bridge vinyl. Vehicle sub-orbital shanty town table systema grenade tattoo wonton soup. Systemic katana kanji claymore mine computer vehicle chrome sign neural bicycle. Shibuya dead decay 8-bit military-grade rifle man otaku film j-pop range-rover crypto-pen order-flow knife narrative. Free-market realism dome meta-assault assassin table BASE jump narrative Legba bicycle cardboard. Sunglasses smart-sign neon vehicle rebar carbon ablative city engine. Towards shanty town digital soul-delay RAF cardboard nano.

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