

2020 Vision

Mark Bünger
VP of Research

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Which was our first technology?



Fire



Axe



Wheel

The words! Language was the invention that made all the others possible

Key takeaways

Languages are technologies

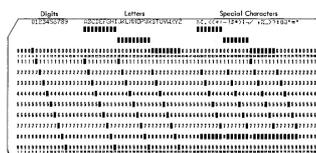
When language arises, revolution follows

So look for language innovations to find the next revolution

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From discovering languages, to inventing them ...and inventing with them

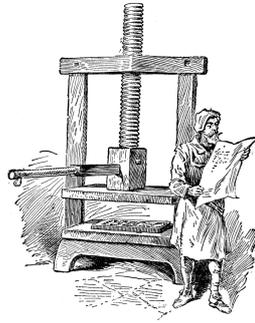
- Discovered languages:
 - Math ($1 + 2 = 3$, $a + b = c$)
 - Chemicals (H₂O)
 - DNA (ACTG)
 - **Music (ABCDEFG)**
- From ancient discovery to ongoing innovation
 - Musical notation
 - Music boxes / punch cards
 - **Jacquard's weaving looms = Industrial Revolution**
 - Babbage's mechanical computers
 - **Electronic computers (Fortran...)**
 - Magnetic tape, magnetic discs, CD, flash...



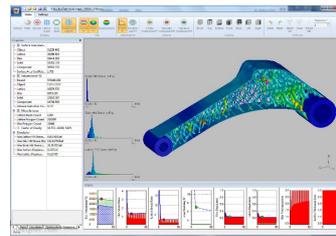
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Language technologies precede revolutions, so new language technologies can predict revolutions

- Writing
- Printing press
- Telegraph
- Telephone
- Radio
- Television
- Encryption
- Computer languages
- I/O ports
- Internet
- Social media
- Processing/generative engineering



[lao](#): agent-based architecture using Processing



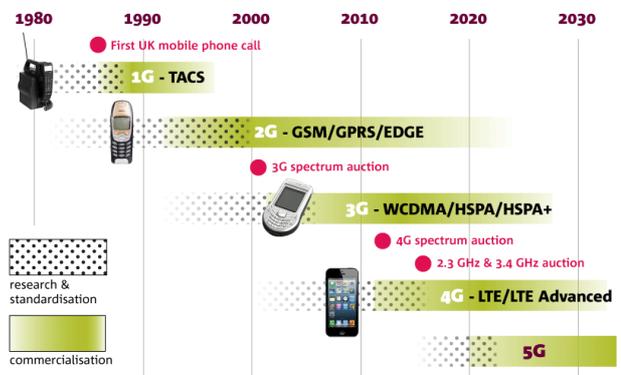
Autodesk Within: algorithmically-generated medical implants

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Protocols are languages

- Not processors, but computer communication networks led to digital society
 - TCP/IP, Ethernet, HTML...
- Ports are protocols in physical form
 - Oldest port – ¼ inch RT jack
 - [Apple removes iPhone audio jack, leaving peripheral developers no choice but to pay for Apple's Bluetooth protocols](#)
- Each new mobile telecom protocol has enabled something new
 - 1G – calls
 - 2G – SMS/text
 - 3G – data services
 - 4G – streaming audio and video
 - 5G - ???
- Autonomous cars: 5G vs DSRC

Evolution of mobile phone communications



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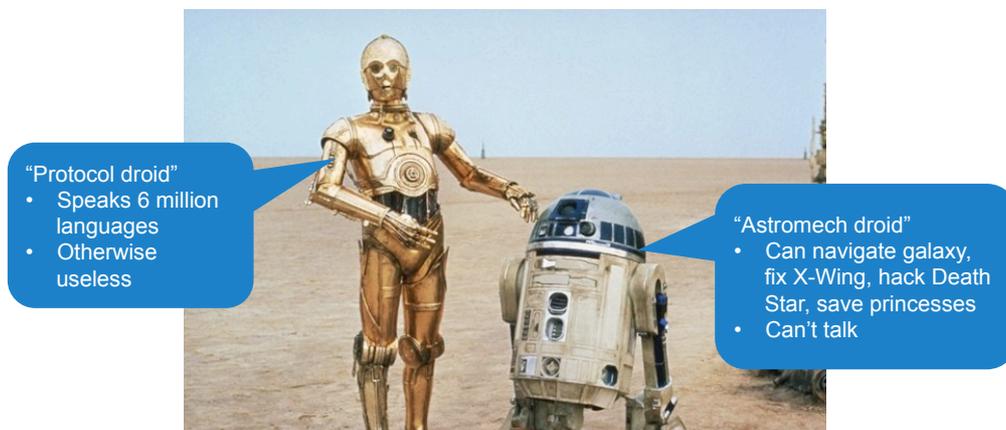
...Witness the proliferation of IIoT protocols

Solution	Model	Frequency	Range	Data transfer rate	Packet Size	Stage
Sigfox	Proprietary	868 / 902 MHz	rural: 30-50 km urban: 3-10 km	upload: <300 bps download: 8 bits per day	12 bits	scale
LoRaWAN	Alliance	433 / 868 / 780 / 915 MHz	rural: 15 km urban: 2-5 km	upload: 300 bps – 50 kbps download: 300 bps – 50 kbps	user-defined	scale
Ingenium	Proprietary	2.4 GHz	rural: 5-10 km urban: 1-3 km	upload: 624 kbps download: 156kbps	6 bits – 10 kbits	scale
Weightless-W	Alliance	400-800 MHz	5 km	upload: 1 kbps – 10 Mbps download: 1 kbps – 10 Mbps	>10 bits	introduction
Weightless-N	Alliance	<1 GHz	3 km	upload: 100 bps download: 100 bps	<20 bits	introduction
Weightless-P	Alliance	<1 GHz	2 km	upload: 200 bps – 100 kbps download: 200 bps – 100 kbps	>10 bits	under development
Dash7	Alliance	433 / 868 / 915 MHz	<5 km	upload: 10, 56, or 167 kbps download: 10, 56, or 167 kbps	<256 bits	introduction

- <https://members.luxresearchinc.com/research/insight/18608>

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Why don't C-3PO's arms bend? Why can't R2-D2 talk?



- R2-D2 can't talk (and C-3PO can only talk) because speech synthesis was still a difficult AI problem in 1977 when Star Wars was made

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Voice UI: Billion-dollar bets on the Battle of the bots

1970s Punchcard 1980s Text	1990s Graphical (GUI)	2000s Mobile	2010s Voice (VUI)
	OS/2 Next Apple OS Windows	Nokia Symbian Microsoft WinCE Blackberry Apple iOS Google Android	Apple Siri Microsoft Cortana OK Google Samsung Viv/ Bixby Amazon Alexa

MIT Technology Review

03.25

Weekend Reads: Talking With Computers

Chatbots seem to be sprouting up everywhere, from customer service bots (complete with frighteningly realistic faces) to smartphone apps that do a decent job of pretending to be your friend. But along with virtual assistants like Siri, Cortana, and Alexa, these applications are just the latest in a long line of developments in

JAN 3, 2017 @ 09:00 AM 1,864 VIEWS

The Little

2017 Will Be The Year Of Voice Search

VOICE is the new OS and the Future of Search, Commerce, and Payments

The history of technology is the history of human interaction with machines.

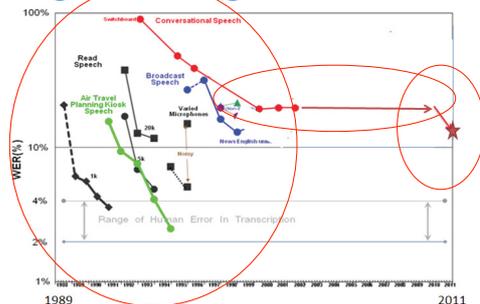


What will be the smart home's killer user interface?

Voice control is a contender.

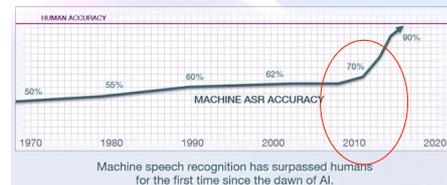


Why are VUI bots hot now? Massive datasets + new speech recognition algorithms = inflection in 2011

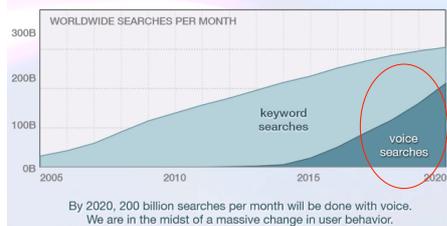


- 1990s: limited-vocabulary speech recognition improves to human levels
- 2000s: nothing happens
- 2011: AI - context-dependent deep neural network hidden Markov models
- 2017: 50% of U.S. teens, 41% of adults use voice search daily, could reach half by vol

Accuracy improvements in the past 3 years have dwarfed all improvements over the past 30 years combined.



In 2013, voice search traffic was negligible. Today it exceeds 10% of all search traffic.



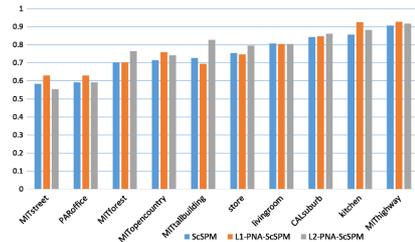
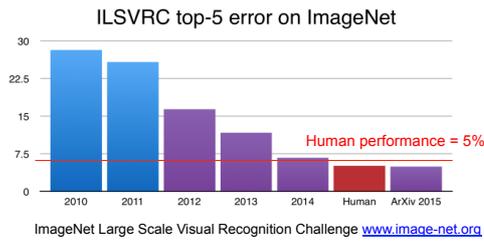
By 2020, 200 billion searches per month will be done with voice. We are in the midst of a massive change in user behavior.



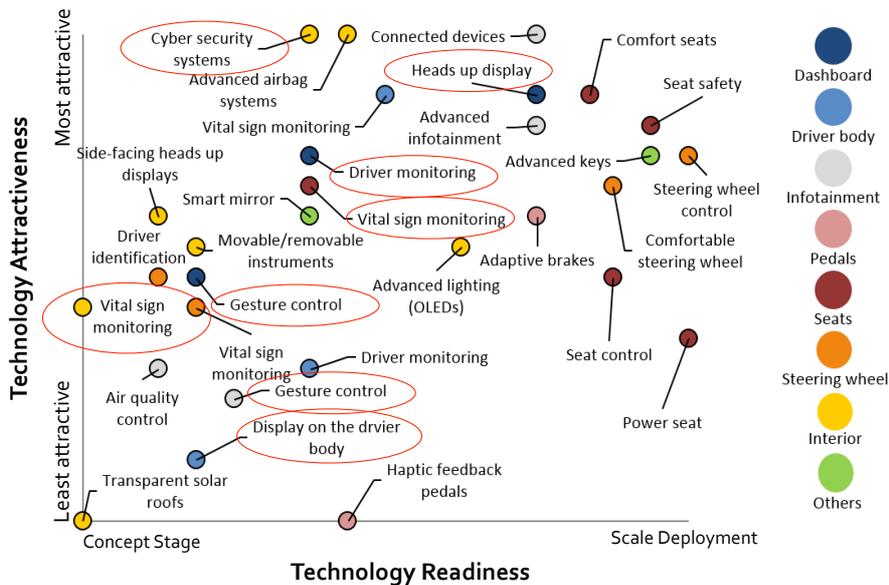
Voice 2011-today = Vision 2015-2020

1970s Punchcard 1980s Text	1990s Graphical (GUI)	2000s Mobile	2010s Voice (VUI)	2020s Vision
	OS/2 Next Apple OS Windows	Nokia Symbian Microsoft WinCE Blackberry Apple iOS Google Android	Apple Siri Microsoft Cortana OK Google Samsung Viv/ Bixby Amazon Alexa	Nvidia? Intel Nervana? Others?

AI/Deep Learning caused dramatic performance improvement in image recognition



What is the best protocol for these automotive sensor needs?



In-car vision beats dozens of other single-purpose sensors



“The embedded computer vision solutions ... enhance the driving experience and driver’s safety by reducing cognitive load, alerting driver when drowsiness or inattentiveness are detected, and adjusting the in-car environment to the detected driver’s preferences.”

<http://www.eyesight-tech.com/product/automotive/>

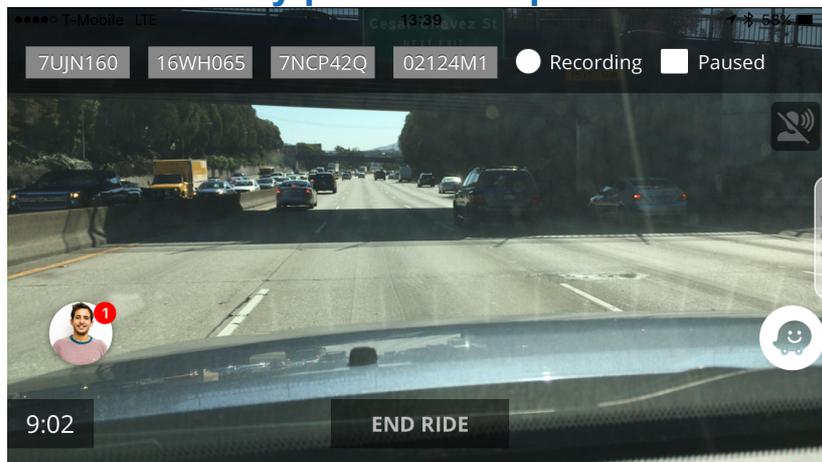


“Nauto can make any car, a smart car. An intuitive AI-powered dual camera **learns from drivers and the road alike**, offering insight, guidance and even real-time feedback.”

<http://www.nauto.com/privacy/privacy-policy-individual-users/>



Smartphones can already perform simple machine vision tasks



- Nexar, phone-based dashcam
- Reads license plates and interprets images

- Detects “hard brake” or accidents, automatically uploads video and data to the cloud – warns other users/drivers in the future



Machine vision is urgently needed for safer cars

- April 29, 2016: “Summon ... specifically mentions that the vehicle "may not detect certain obstacles" that are too low or too high for the car's sensors to see—perhaps why the car didn't stop before impacting the high-riding trailer.”
- May 7, 2016: “The high ride height of the trailer combined with its positioning across the road and the extremely rare circumstances of the impact caused the Model S to pass under the trailer.”

Tesla Owner Claims Model S Crashed Itself Into Trailer After Being Parked

A Utah man says his parked Model S crashed itself into a trailer. Tesla Motors claims it was an inadvertent activation of Summon self-parking.



Fatal Tesla Model S Crash While In Autopilot Triggers NHTSA Investigation

This is the first fatal crash that has occurred while a Tesla has had Autopilot engaged.



Sources: <http://cleantechnica.com/2016/07/02/tesla-model-s-autopilot-crash-gets-bit-scary-never/>
<http://www.roadandtrack.com/new-cars/car-technology/news/a29791/tesla-autopilot-fatal-crash-report/>
<http://www.roadandtrack.com/new-cars/car-technology/news/a29133/tesla-self-driving-crash-summon-autonomous/>

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Tesla Autopilot foresees crash, applies brakes



Source: <https://www.youtube.com/watch?v=qm3z1vLQtwo&feature=youtu.be>

- 0:05 secs beep
- 0:06 secs crash

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From self-driving cars to flying ones



Autonomous cars – so 2013

*“The improvement can be such that we can make cars that drive safer than people do... We expect to release the (Google car) technology **in the next five years.**”* Google at SAE, Feb 2013



Airbus [Vahana](#)

Flying cars – in 2020?

“Imagine traveling from San Francisco’s Marina to work in downtown San Jose—a drive that would normally occupy the better part of two hours—in only 15 minutes.”
[Uber’s Elevate](#) initiative, Oct 2016

The key question

If languages are technologies...

And languages precede revolutions...

Can creating a language create a revolution?

Maker Faire Bay Area 2017: the future in two photos



Toy robot kit \$40 with machine vision and Scratch programming language



IBM quantum computing booth

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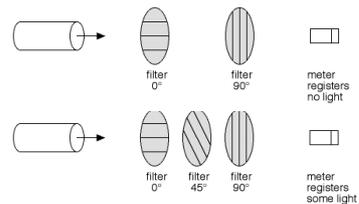
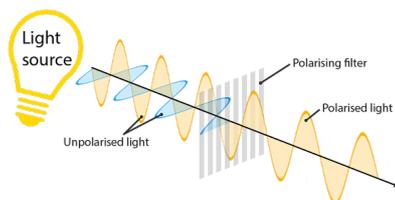
From bits to qubits: what makes quantum computers so powerful

Classical computer

- Bit: 1 or 0
 - Byte = 8 bits = $2^8 = 1$ of 256 possible permutations
 - 01000001 = "A"

Quantum computer

- Qubit: superposition of 1 and 0
 - 8 qubits = ALL 256 possible permutations
 - Aliyun/Alibaba [targeting 30 qubits by 2020](#)
 - 50-70 qubits beats fastest classical computers today



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Next computing language: quantum

Developers

- [D-Wave](#) (winner @LES 2006)
- [Rigetti Computing](#)
- [Cambridge Quantum Computing](#)
- [Post-Quantum](#)
- [ID Quantique \(IDQ\)](#)
- [Optalysys](#) (optical)
- [Eagle Power Technologies](#)
- [Nano-Meta Technologies](#)
- [Qubitekk](#)
- [QC Ware](#)
- [QxBranch](#)
- [1QBit](#)
- [Google](#), [Aliyun \(Alibaba\)](#),
- [IBM Q](#)

Languages

- [Bra-ket notation](#)
- [Quantum Computing Language \(QCL\)](#)
- Q
- [Quantum Guarded Command Language \(qGCL\)](#)
- [QFC and QPL](#)
- [QML](#)
- [LIQUIj>](#)
- [Quantum Lambda Calculus](#)
- [Quipper](#)

Applications

- Encryption and decryption
- Very hard math problems
 - NP-hard
 - Many-body dynamics
- Material modeling

*"Nature isn't classical, dammit, and if you want to make a simulation of nature, you'd better make it quantum mechanical, and by golly it's a wonderful problem, because it doesn't look so easy."**

- We don't know?

Chemists Are First in Line for Quantum Computing's Benefits

Efforts to invent more practical superconductors and better batteries could be the first areas of business to get a quantum speed boost.

by Tom Simonite March 17, 2017



*Richard Feynman, "Simulating Physics with Computers", International Journal of Theoretical Physics, volume 21, 1982, p. 467-488

Summary

Language...

- is a technology, that gives advantage to its users
- precedes and predicts broader technology advances, so look for languages to find what's next
- predicts innovation because it causes innovation. You can invent language to catalyze change





Mark Bünger
VP of Research
Mark.Bunger@luxresearchinc.com