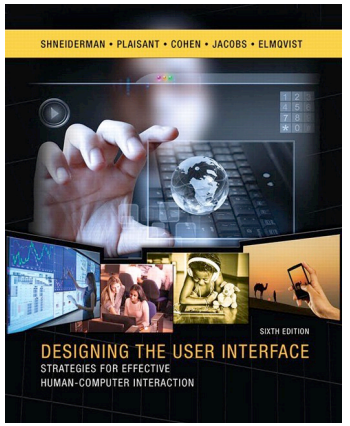
Unit 08

Design Considerations – part 2

- Human and Command languages
- Interaction Devices
- Communication and Collaboration

Shneiderman, 6th Edition,
chapters 9, 10, 11



Human and Command Languages

Topics

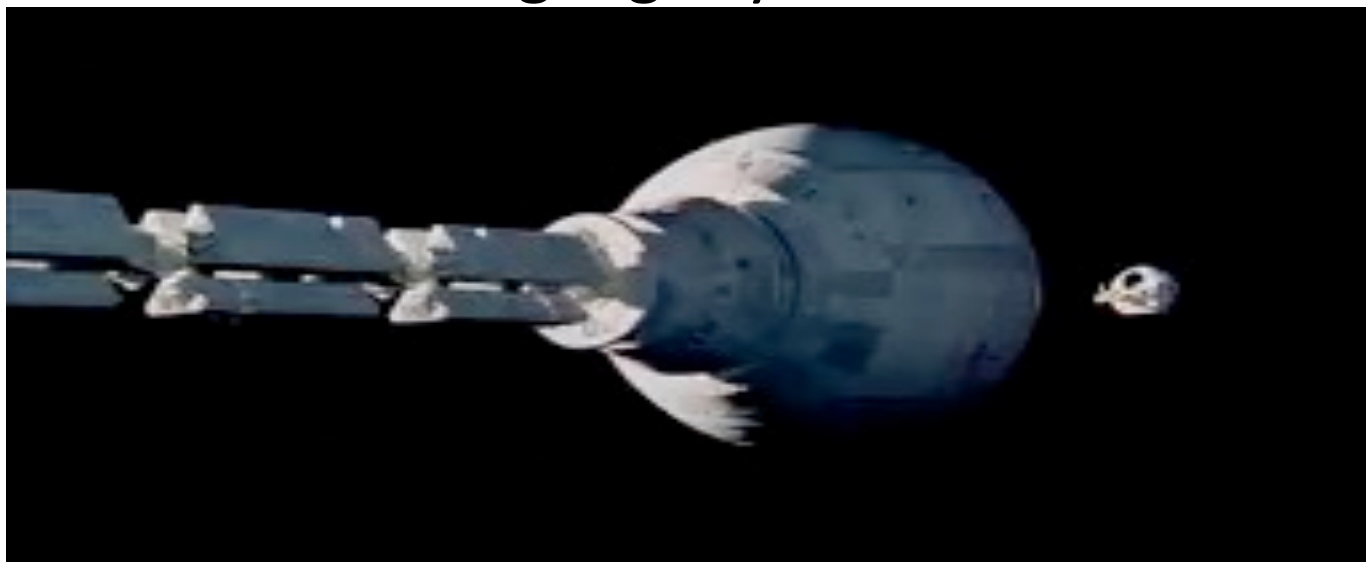
1. Introduction
2. Speech recognition
3. Speech production
4. Human language technology
5. Traditional command languages

Introduction

- The use of command languages in the early days of computing (e.g., DOS or Unix) receded with the advent of graphical user interfaces and direct manipulation.
- Command languages are still in use:
  - by expert users in terminals and command shells
  - in tools like MATLAB that combine command language and graphical environments
  - in speech interfaces in interactive voice systems (IVS)
  - in speech interfaces by personal assistants, hands-free interaction with devices, web search, etc.

Introduction

- The dream of speaking to computers and having computers speak has long lured researchers and visionaries. Arthur C. Clarke's 1968 fantasy of the HAL 9000 computer in "**2001: A Space Odyssey**" has set the standard for performance of computers in science fiction and for developers of natural language systems



Speech Technologies

While understanding natural language remains an unattainable dream, there are many applications that can successfully make use of the words people say, type, or listen to. Examples :

- Store and replay speech as in museum guides (canned speech)
- Dictation (document preparation, web search), see Google Docs -> Tools -> Voice Typing
- Subtitling, transcription, (e.g. Youtube)
- Transactions over the phone (Interactive Voice Systems)
- Personal “assistants” (common tasks on mobile devices)
- Hands-free interaction with a device
- Adaptive technology for users with disabilities
- Translation
- Alerts
- Speaker identification

Speech Recognition

Spoken input has recently gained acceptability, driven by the difficulty of typing while using mobile devices.

e.g. "where is the closest restaurant?"

Background noise and variations in user speech performance make recognition more difficult.

Exercise: Use google docs **voice typing** to dictatea text in different languages, measure the errors,variate the background noise (music).

Spoken vs hand/eye input

Spoken commands are more demanding of users' working memory than is hand/eye coordination and thus may be more disruptive to users while they are carrying out tasks. Hand /eye coordination is processed elsewhere in the brain, than problem solving, enabling a higher level of parallel processing. (Radvansky and Ashcraft, 2013).

Speech interaction opportunities

- When users have physical impairments
- When the speaker's hands are busy
- When mobility is required
- When the speaker's eyes are occupied
- When conditions preclude use of a keyboard
- When application domain vocabulary and tasks is limited
- When the user is unable to read or write (e.g. children)

Speech interaction obstacles

- Interference from noisy environments and poor-quality microphones
- Commands need to be learned and remembered
- Recognition may be challenged by strong accents or unusual vocabulary
- Talking is not always acceptable (e.g. in shared office, during meetings)
- Error correction can be time consuming
- Increased cognitive load compared to typing or pointing
- Math or programming difficult without extreme customization

Obstacles to speech output

- Slow pace of speech output when compared to visual displays
- Ephemeral nature of speech
- Not socially acceptable in public spaces (also privacy issues)
- Difficulty in scanning/searching spoken messages

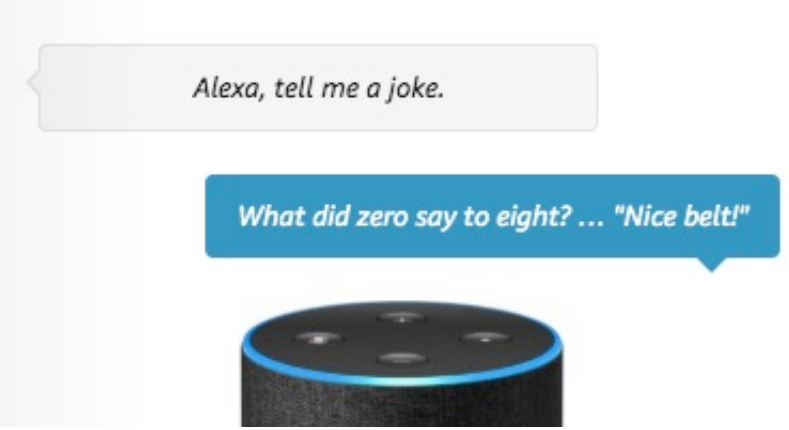
Speech recognition applications

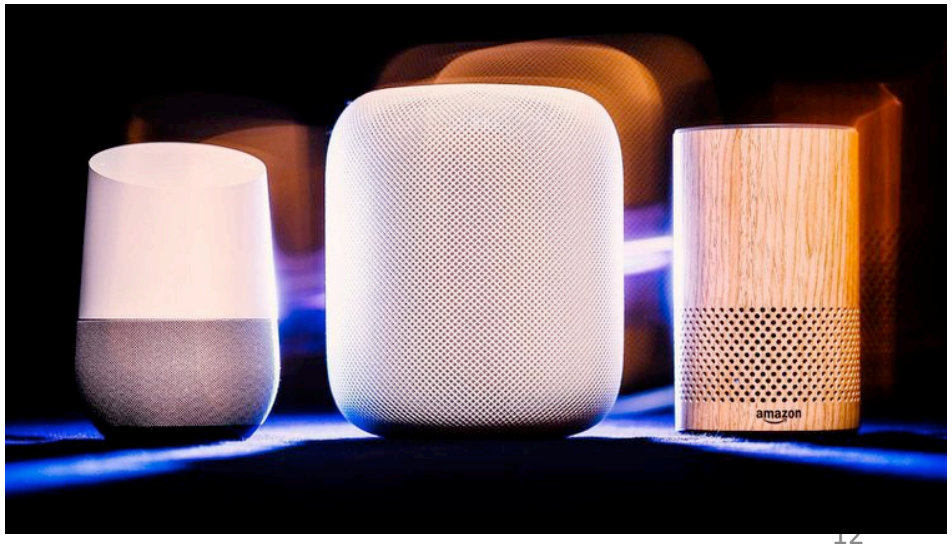
Technical fields with a lot of jargon are good candidates for speech recognition because of the distinctive nature of the terminology and the often constrained documentation needs.

Example: Electronic health records (HER) dictation) **Nuance Dragon Medical Advisor ®**

Voice-activated Digital Assistants

- Speaking assistants are now widely available, but many users never use them; others use only the few commands that they have learned and can remember.
- The demonstrations are impressive, but the comparison tests often reveal problems (Ezzohari, 2015).
- **Home appliances** have been recently developed (e.g. Amazon echo)





amazon alexa

Alexa

Google Assistant

Siri

Designing spoken interaction

- First we need to decide whether the interaction will be conducted entirely via the audio channel using speech recognition and production; (e.g., on the phone or when users are driving or have visual impairments).
- Alternatively, we may integrate voice and visual channels to provide informative feedback or display results on the screen of a mobile device or a computer (Oviatt and Cohen, 2015).
- In general, combining input by voice with visual output is much preferable, as reading on the screen is much faster than listening to long prompts and allows rapid selection.

Initiation spoken interaction

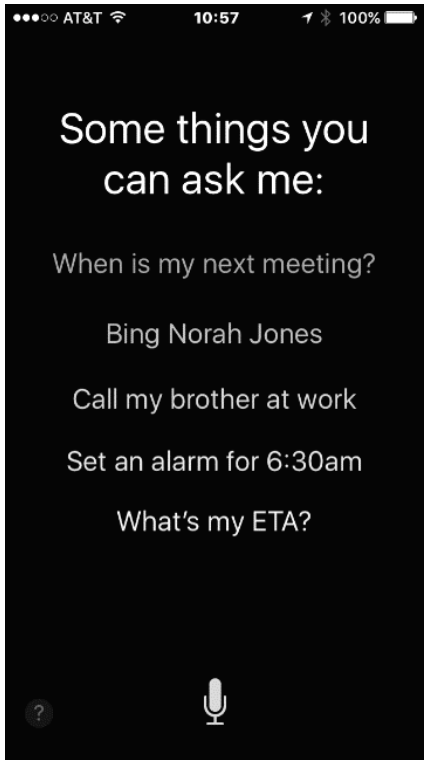
- The first step in using spoken interaction is to allow users to indicate that they wish to start the spoken interaction.
- In phone systems, a welcome prompt is sufficient.
- On the screen, a **start button** is needed (usually in the shape of a microphone), or an option is available to use a **voice command** to turn on the listening (e.g., "Hey

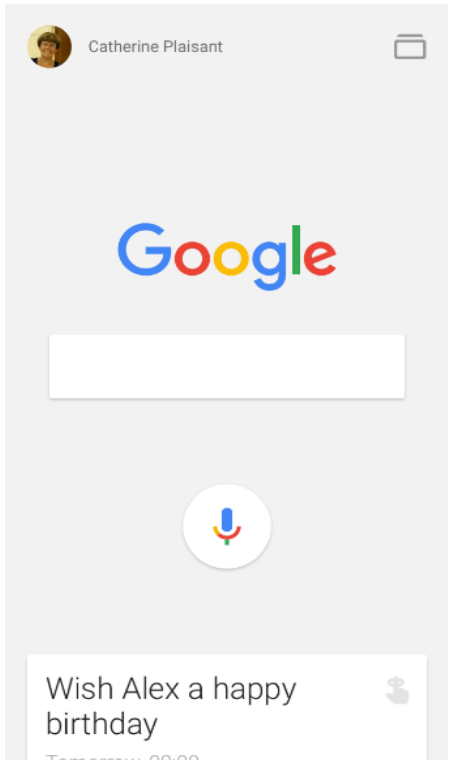
  Siri" or "Wake up").
- This command has to be very carefully chosen so that it is not misrecognized, but false positives will inevitably occur, causing frustration.

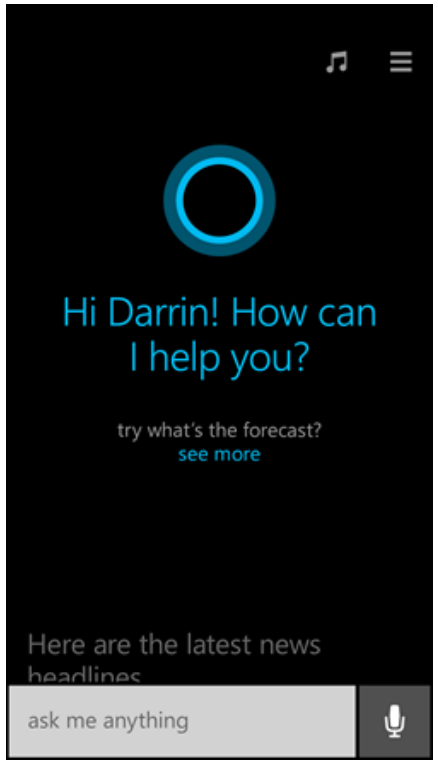
Knowing what to say

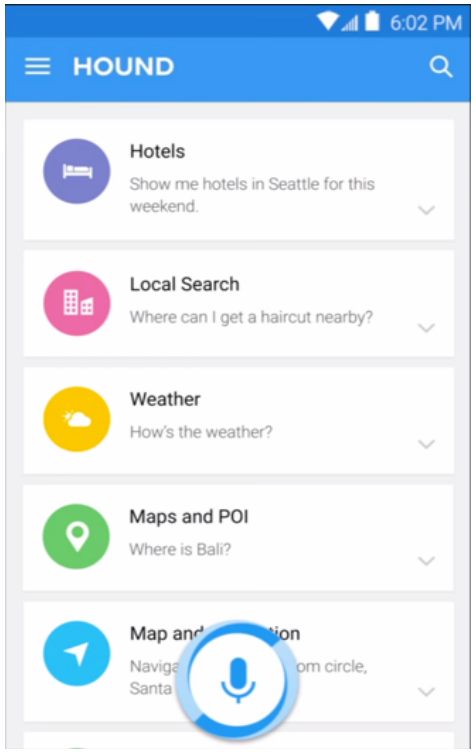
- Learnability is one of the main issues of human language technologies. Users need to know what can be said and reliably recognized.
- In IVR phone systems, spoken prompts guide users and invite them to press keys or speak one of the proposed menu choices. Transactions remain simple and the dialogue entirely directed (e.g., please say "account balance," "bill pay," or "fund transfer").
- Users of mobile digital "assistants" are left with the burden of learning and remembering the commands.
- They may quickly become frustrated and quit if none of their attempts leads to success.

Knowing what to say - examples









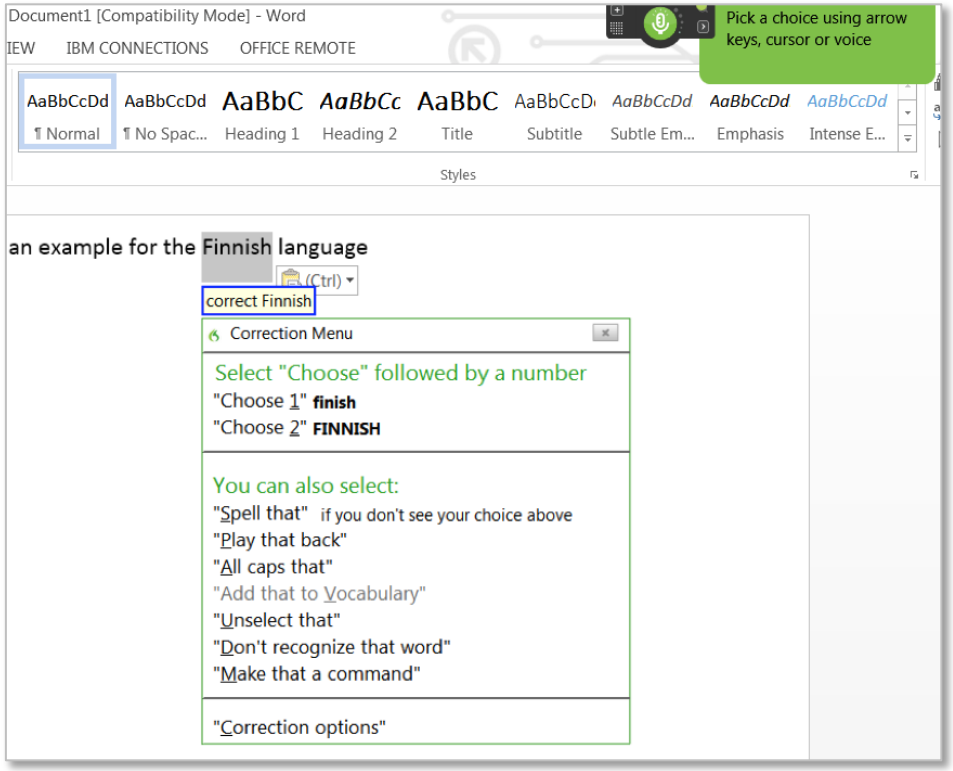
Mobile devices assistants (Siri, Google Assistant, Cortana and SoundHound) all have similar microphone buttons, but different ways of presenting suggestions

Recognition of errors

- Robustness of speech recognition remains a major research challenge. (Huang et al., 2014)
- This problem was highlighted in the IBM technical report: "How to Wreck a Nice Beach“ (aka "How to Recognize Speech").
- Early speech recognition systems were speaker dependent, and users were required to train the system to recognize their voice. This is not the case anymore for mobile phone use.

Correction of errors

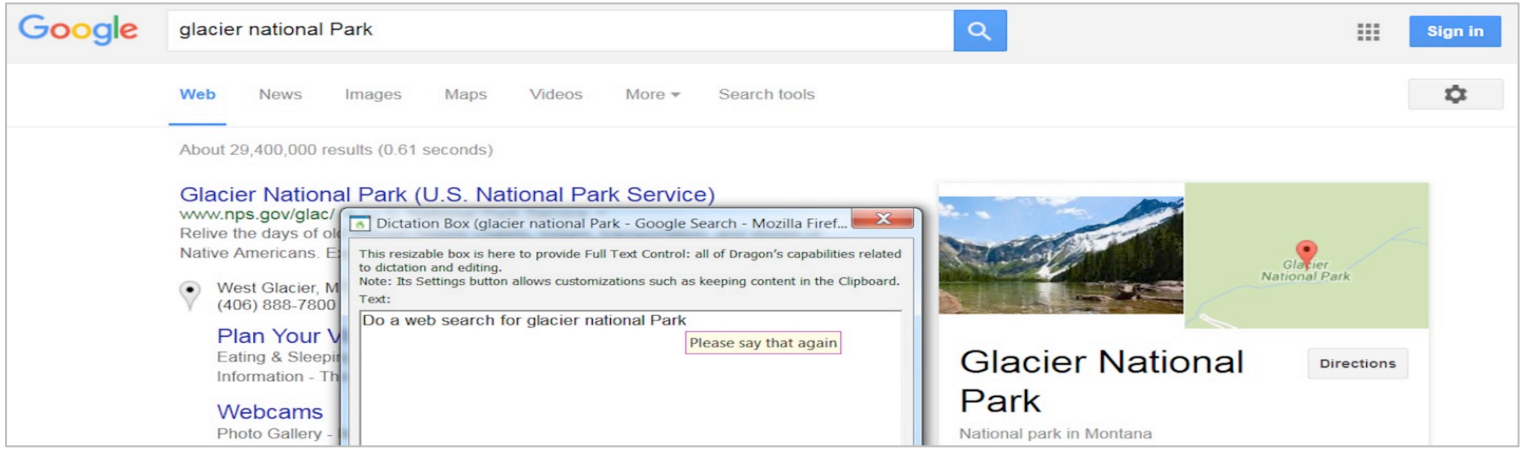
Correcting errors can be very demanding, especially when users do not have access to a keyboard or pointing device so all corrections have to be done using speech.



In Nuance Dragon after saying “Correct Finnish” the word is selected and possible corrections are displayed in a menu, along with additional commands such as “Spell that” Users can use the cursor, arrow keys, or voice to specify their choice

Mapping to possible actions

- Successful speech recognition applications today are limited to narrow application domains.
- Mapping the recognized text to the most appropriate action is the most challenging task (Ezzohari, 2015).
- It can be difficult to remember what exact command will accomplish the task
- Example: when the user said “Search the web for Glacier National Park” a Google search was launched and a search executed with the correct terms, but when the user said “Do a web search for Glacier National Park” the text was indeed accurately recognized but not as a command, so the text was placed in the Nuance Dragon™ dictation box



Feedback and dialogues

- Commands are usually **executed directly**, unless confirmation is preferable (e.g., "I am ready to e-mail this to X, should I go ahead?")
- Sometimes additional information or disambiguation is needed (e.g., "There are 2 John Smiths in your address book, which one should the e-mail be sent to?").
- The availability of a display can greatly speed up interaction

Spoken commands

In order to define the commands the design needs to study the users' task domain and their "natural" speak.

```
give me help
give me help on commands
[ ( go | move ) ] ( ( ( back | backward | backwards ) | ( forward | forwards ) ) | ( up | down ) ) ( one | a ) line
[ ( go | move ) ] ( ( ( back | backward | backwards ) | ( forward | forwards ) ) | ( up | down ) ) ( twenty | ... ) lines
( go | move ) ... [ ( ( one | one ) | ( twenty | ... ) ) ]
[ ( go | move ) ] ( ( left | right ) | ( ( back | backward | backwards ) | ( forward | forwards ) ) ) ( one | a ) character
[ ( go | move ) ] ( ( left | right ) | ( ( back | backward | backwards ) | ( forward | forwards ) ) ) ( twenty | ... ) characters
( go | move ) to [ the ] ( bottom | end )
( go | move ) to [ the ] ( bottom | end ) of [ the ] ( line | document )
( go | move ) to [ the ] ( start | top | beginning )
( go | move ) to [ the ] ( start | top | beginning ) of [ the ] ( line | document )
go to sleep
go_to_sleep
help me
```

- Example: a subset of the rich set of commands used in the Nuance Dragon™ speech recognition system (see use of synonyms)

Speech Production

- Speech production is usually successful when the messages are simple and short; and users' visual channels are overloaded
- There are three general methods to produce speech:

1. Formant synthesis - machine-generated speech using algorithms
2. Concatenated synthesis - uses tiny, recorded human speech segments
3. Canned speech - fixed, digitized speech segments

Speech Production examples

- Audio books or audio tours
- Instructional systems
- Online help systems
- Alerts and warnings
- Applications for the visually impaired (screen readers)

Speech Production example: IBM Watson TTS

https://text-to-speech-demo.ng.bluemix.net/

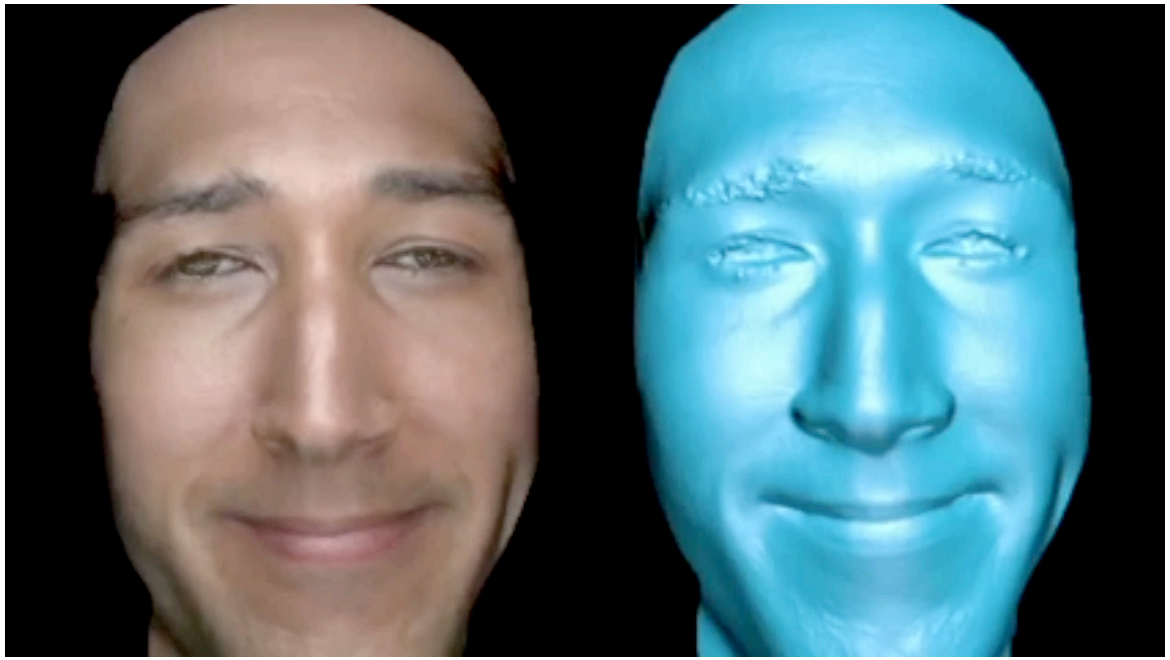
Human Language Technology

- Contrary to common belief, human-human interaction is not necessarily an appropriate model for human operation of computers.
- Since computers can display information 1,000 times faster than people can enter commands, it is advantageous to use the computer to display large amounts of information and to allow users simply to choose among the items.
- Visual interfaces provide the cues for the semantics of interaction, but Natural Language interfaces typically depend on assumed user models.
- Users who are knowledgeable about their tasks - for example, stock-market brokers who know the stock codes (objects) and buy /sell actions can place orders in natural language, but these users prefer compact command languages because they are more rapid and reliable.

Human Language Technology

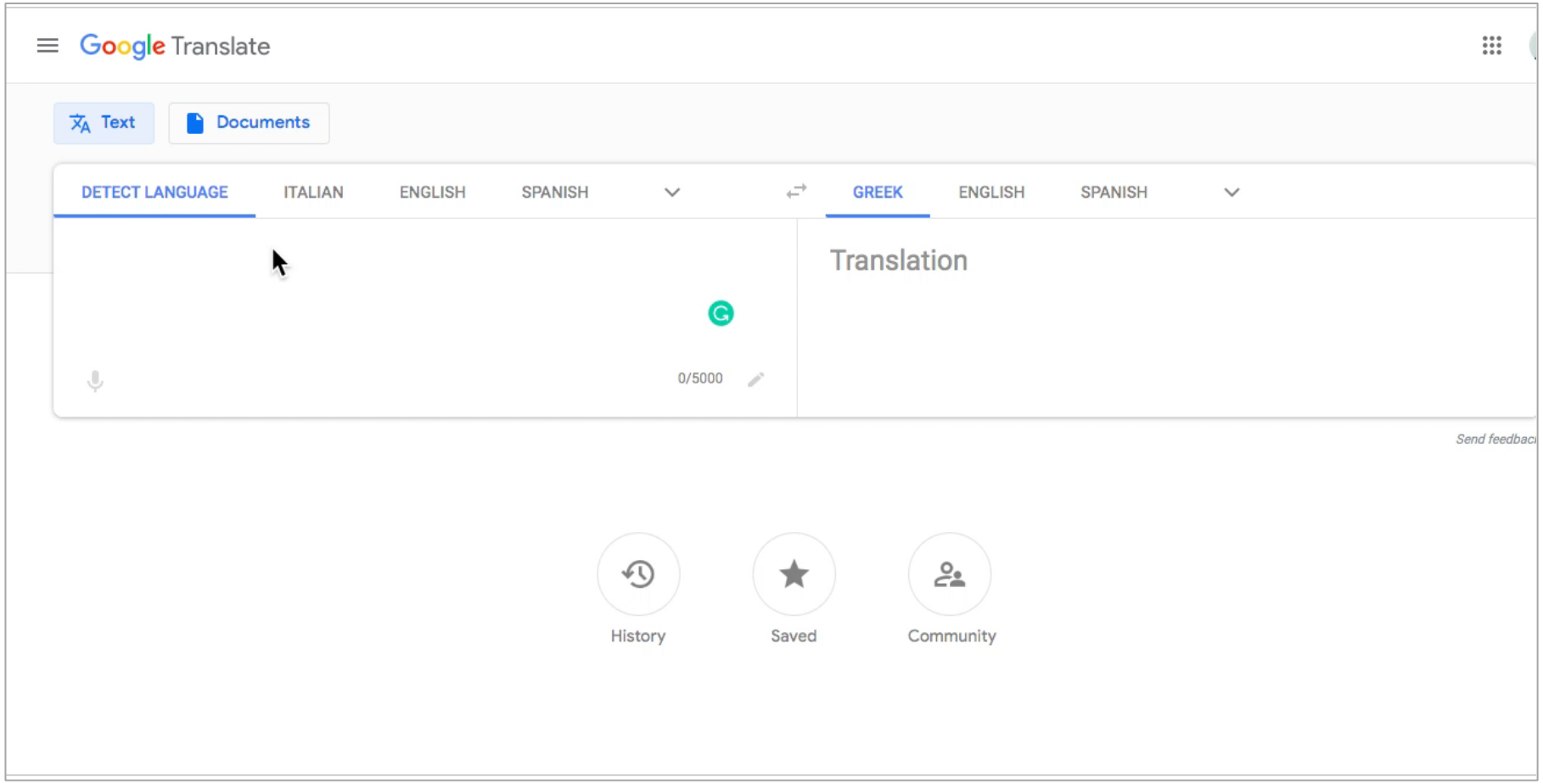
- Machines that understand natural language
- Natural language interaction (NLI)
  - Series of exchanges or “dialog” is difficult to design and build, on even a single topic
  - Current successes often rely on statistical methods based on the analysis of vast textual or spoken data from millions of users
- Example applications and methods include:
  - Question answering strategies
  - Extraction and tagging, e.g. gathering data from a database of medical records
  - Human language text generation
  - Instructional systems, better learning with typing than speaking
  - Language translators, e.g. Google Translate

Human Language Technology example: the INOTS DIVE



- Using the Immersive Naval Officer Training System (INOTS) new navy officers can practice their counseling skills in a virtual reality environment
- Officers listen to an avatar and respond using spoken language, loosely following suggestions from multi-choice prompts presented on the screen and designed to match the learning objectives
- (Dyke, 2013; https://www.youtube.com/watch?v=K6l9bJSunRg

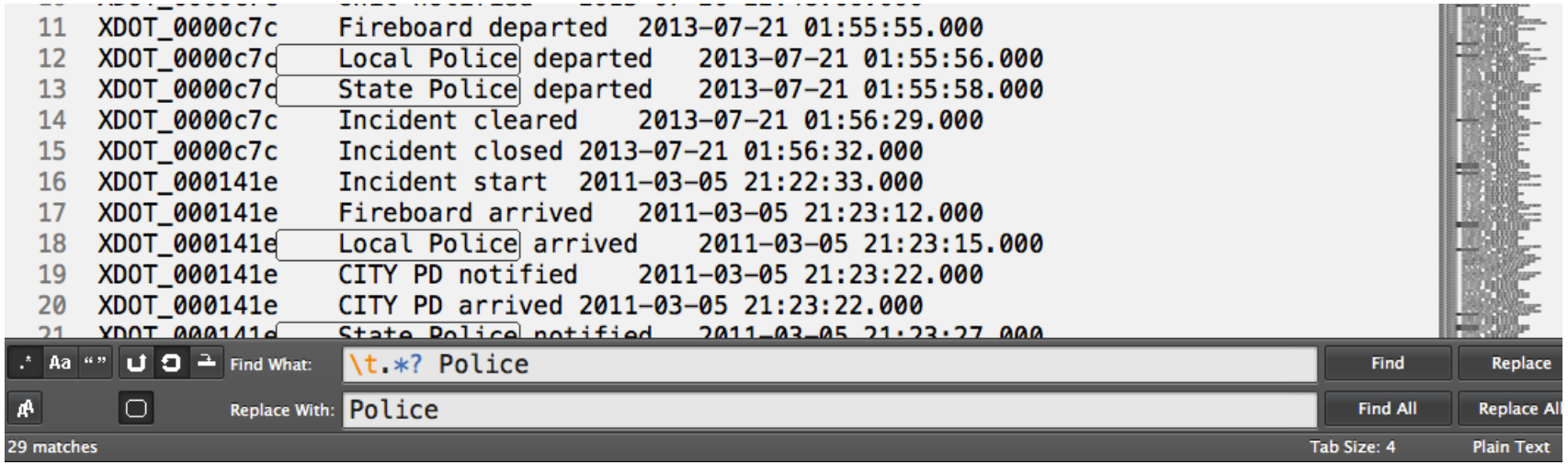
Human Language Technology: automatic translation: Google translate



Command Languages

- Command languages are often preferred by expert users who do not want to drag and drop items for repeated steps.
- A command language example is the Unix command used to delete blank lines from a file
  - `grep -v ^$ filea > fileb`
- Casual users favor GUIs but both styles of interface can be made available successfully
- Other examples that behave like command languages:
  - Web addresses (URLs) can be seen as a form of command language
  - Twitter addresses
  - Database query languages

Command Languages, example



- Using the Sublime text editor a user is doing a search and replace in a data table using regular expressions
- Typing " \t.*? Police" in the search box searches for a tab followed by zero or more character, a space, and then by "Police"
- The patterns found in the document are highlighted with a thin black line in the

  document, showing that both "local police" and "state police" have been found and selected
- An overview of the entire document is visible on the right, revealing the presence of many other matches that can now be replaced all at once.

Devices

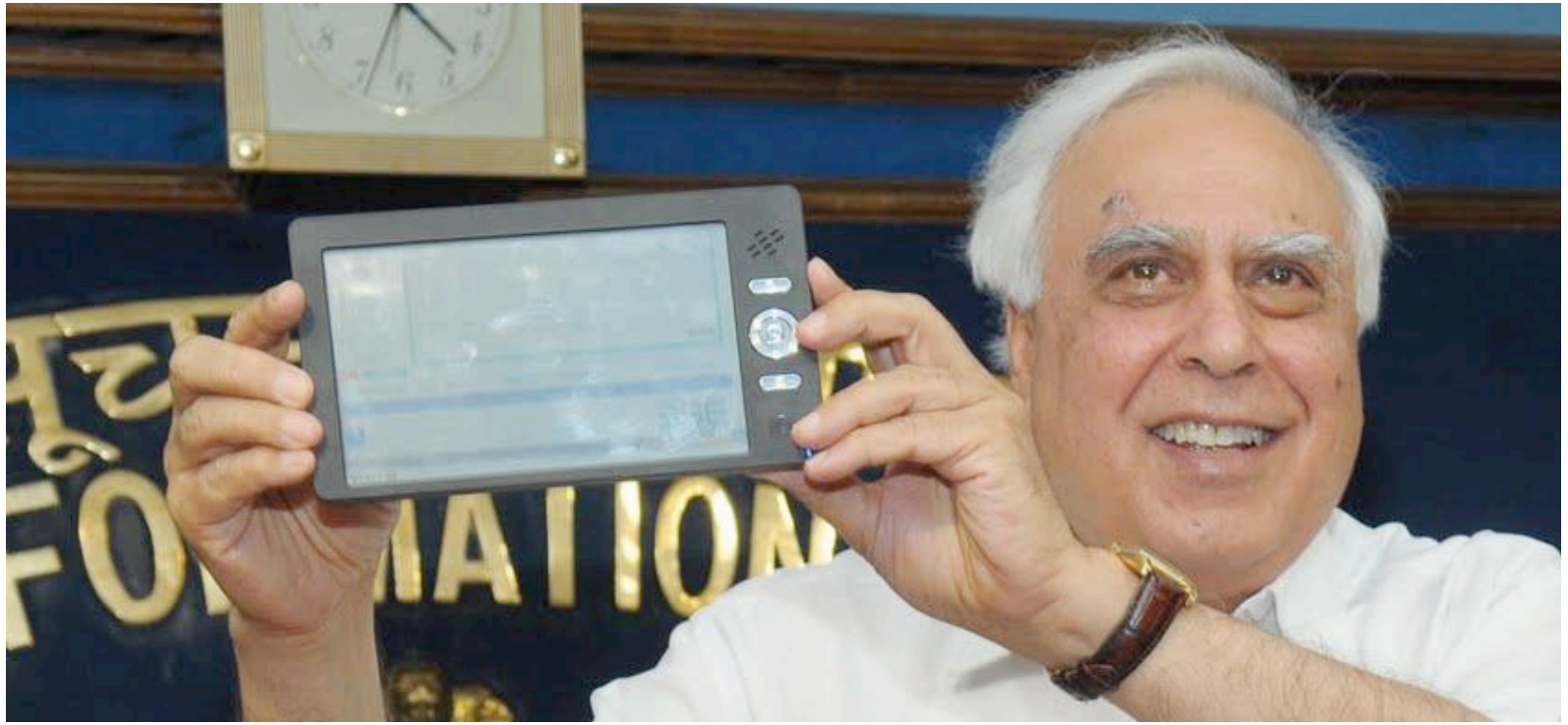
Topics

1. Introduction
2. Keyboards and Keypads
3. Pointing Devices
4. Displays

Introduction

- Input and output devices represent the physical medium through which users operate computers
- Only two decades ago, the standard computer platform was the desktop or laptop personal computer equipped with a screen, a mouse, and a keyboard
- Mobile devices have revolutionized the face of computing
  - Many people do not realize that their ever-present smartphones, tablets, or portable MP3 players are, indeed, powerful computers
  - The Apple iPhone and iPad changed smartphones and tablet computing when they were introduced.
- The explosion of new and exciting computing technology has increased the importance of interaction design so as to accommodate such a wide diversity of input and output modalities

Device example: a cheap tablet for Indian schools



Indian IT minister Kapil Sibal announcing the **Aakash**, a $35 tablet for the Indian market in 2011, manufactured by Datawind. The project however did not expand to Indian schools as planned.

Device example: a wearable baby monitor

- The Owlet wearable baby monitor that continuously tracks a baby's heart rate and oxygen saturation using a so-called "smart sock" (left) and wirelessly sends the information to a base station (center)
- The base station is in contact with the internet, and uploads data that parents can access using their smartphone (right)

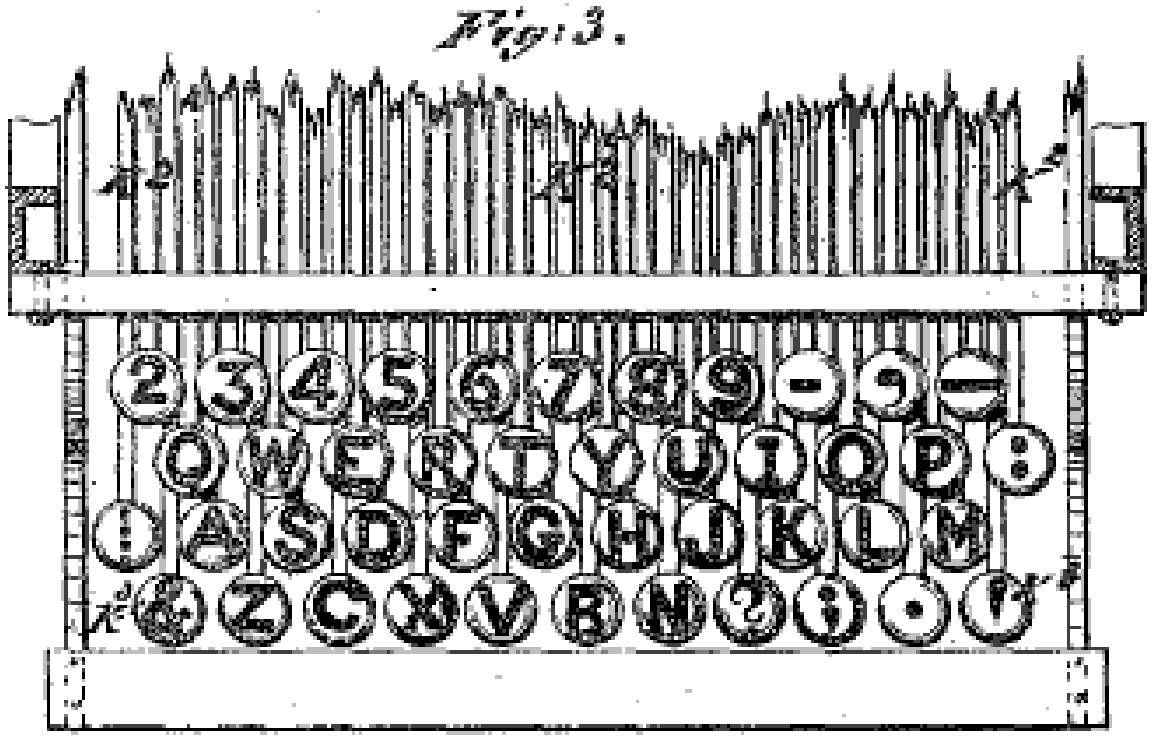
Device example: special device, baby monitor

- Baby monitors use video cameras to provide a real -time feed of the baby's activities on a remote display device (**HelloBaby HB32**)

Keyboards and keypads

- An Apple Macbook Air laptop with a QWERTY keyboard (left) showing the inverted T movement keys at the bottom right and function keys across the top
- A multi-touch trackpad supports pointing
- On the right, a detail photograph of a Lenovo laptop keyboard shows a pointing stick (also called a trackpoint) mounted between the G and H keys on the keyboard

Keyboards and keypads, history

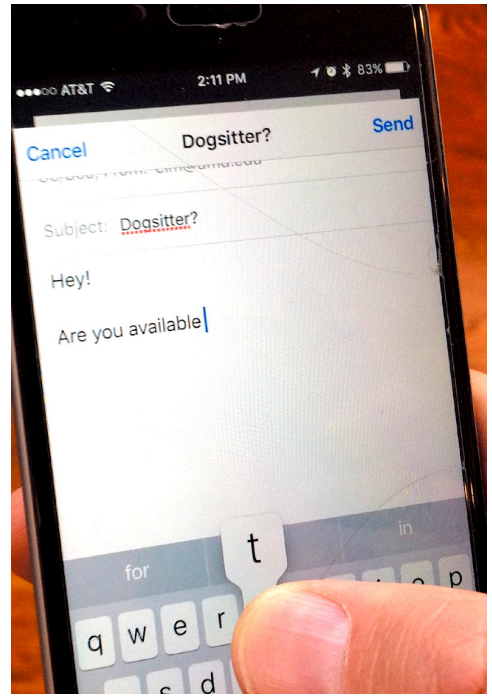


- The QWERTY layout depicted in Christopher Latham Sholes's 1878 patent is slightly different from the modern layout, most notably in the absence of the numerals 0 and 1. (wikipedia)

Accessible “keyboard”

- orbiTouch Keyless Keyboard with integrated mouse functionality suitable for various impairments and finger dex
- The orbiTouch requires no finger or wrist motion to operate, yet supports high-performance typing and pointing
- https://www.youtube.com/watch?time_continue=187&v=LnxSTShwDdQ&feature=emb_logo

text entry in mobile devices



- **Soft keyboards** (on screen virtual keyboards) tend to replace hard keyboards.
- They are difficult to use for eyes-free operation
- Typing speed is around 20-30 wpm, while Expert typists can reach an average of 59 wpm
- A study (Hoggan et al, 2008) demonstrated that providing tactile feedback using the phone's vibration motor could improve typing speed.
- Methods to improve text entry on touchscreens include dictionary based or predictive text-entry algorithms, or language models to predict the word the user is trying to write based on the current sentence; Swype and ShapeWriter (Zhai and Kristensson, 2003) enable typing by tracing letters using a single touch gesture without the need to lift the user's finger, resolving conflicts using a language model.

Pointing tasks and control

- **Select** - Choosing from a set of items (e.g. a menu).
- **Position** - Choosing a position in a one-, two-, three-, or higher-dimensional space (e.g. place a shape in a drawing)
- **Orient** - Choose a direction in a two-, three-, or higher-dimensional space. (e.g. indicate direction of a motion, control a robot arm)
- **Path** - Define a series of positioning and orientation operations (e.g. instructions for cloth cutting, drawing a character)
- **Quantify** - Specify a numeric value (e.g. set the volume of video playback)
- **Gesture** - Perform an action by executing a predefined motion (e.g. swiping to the left to turn a page forward)
- **Text** - Enter, move, and edit text in two-dimensional spac

Pointing devices

Direct control devices (easy to learn and use, but hand may obscure display)

- Touchscreen (single- and multi-touch)
- Stylus (passive and active)

Indirect control devices (take time to learn)

- Mouse
- Trackball
- Joystick
- Pointing stick (trackpoint)
- Touchpad
- Graphics tablet

http://www.logitech.com/

http://www.apple.com/

https://www.ultraleap.com/

Direct control: Touchscreen gestures

Tap

Briefly touch surface with fingertip

Double tap

Rapidly touch surface twice with fingertip

Drag

Move fingertip over surface without losing contact

Flick

Quickly brush surface with fingertip

Pinch

Touch surface with two fingers and bring them closer together

Spread

Touch surface with two fingers and move them apart

Press

Touch surface for extended period of time

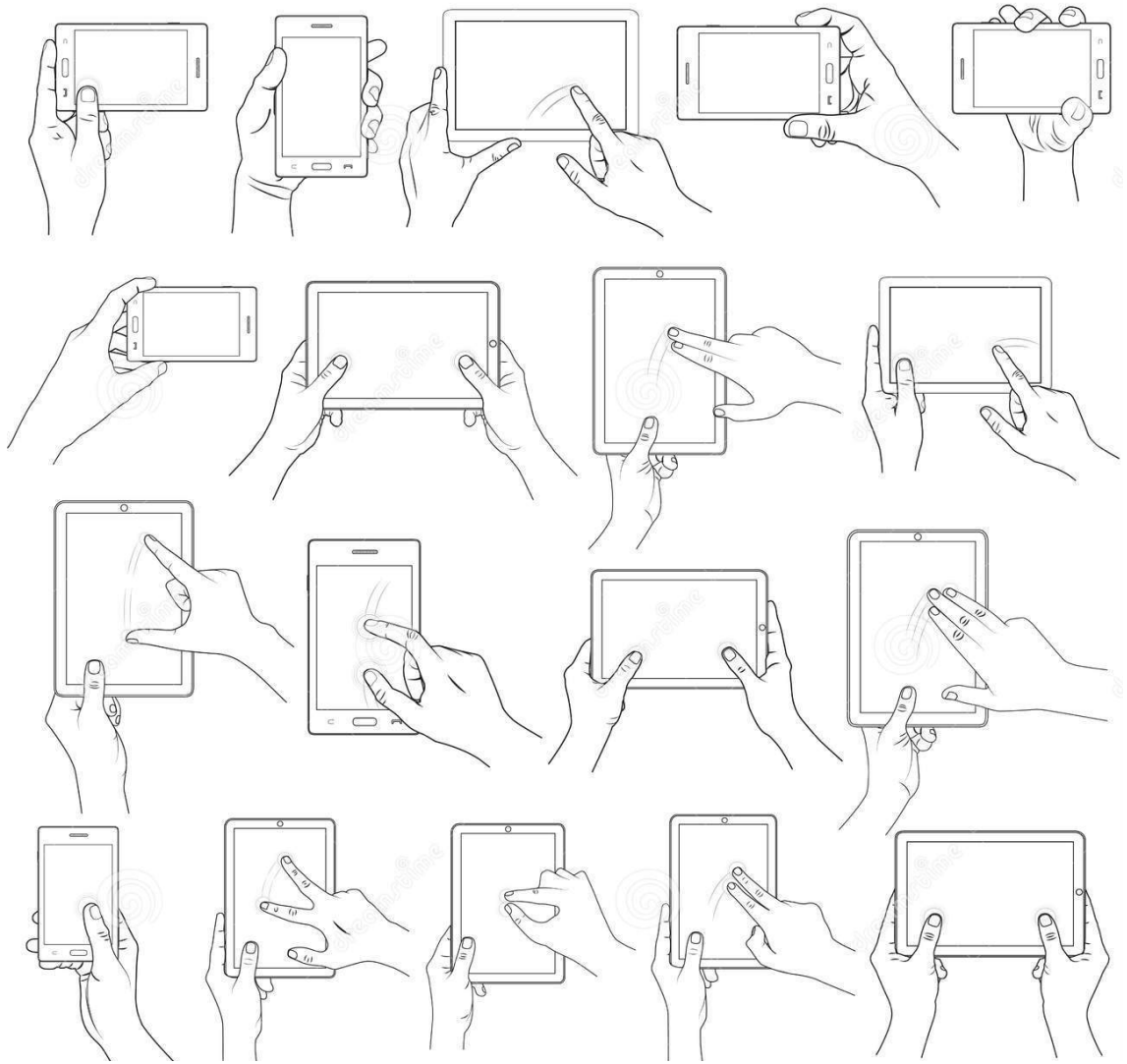
Press and tap

Press surface with one finger and briefly touch surface with second finger

http://i4lcohort.weebly.com/gestures.html

Touchscreen gestures

Two hands holding the mobile device



https://www.dreamstime.com/

Direct control: Touchscreen gestures

- The **resistive, capacitive, or surfaceacoustic- wave (SAW) touchscreens** often provide up to 1600 x 1600 pixel resolution, and the lift-off strategy enabled users to point at a single pixel.
- The lift-off strategy has three steps: Users touch the surface and then see a cursor that they can drag to adjust its position; when they are satisfied, they lift their finger off the display to activate.

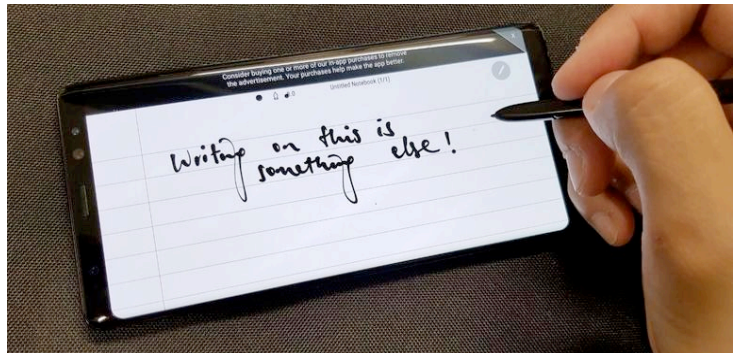
Direct control: the "fat finger" problem

- Pointing using the user's own fingers is prone to the "fat finger" problem, where the user's hand and fingers occlude on-screen content.
- New techniques such as Shift (Vogel and Baudisch, 2007) and occlusion –aware interfaces (Vogel and Balakrishnan, 2010) try to remedy this by displacing the screen content based on the user's touch interaction.

Direct control: use of stylus

Another way to address the "fat fingers" problem is to use a stylus. The disadvantage being to have to pickup and store the stylus.

Samsung has introduced the **s-pen** in many models. Many applications have been taking advantage of the stylus.



Use of **Inkredible** application with s-pen in a Galaxy Note 8 device, other applications that can be used are **MS One Note, Squid, Adobe Photoshop express, Google handwriting input**, various games, etc.

Direct control: use of stylus

A digital artist using a Wacom R 13HD Touch graphical tablet with a wireless stylus (http ://www.wacom.com /). The Wacom pressure -sensitive stylus and graphics tablet allow the precise pointing and accurate control that artists need.

Novel pointing devices

- Bimanual input
- Eye-trackers
- Sensors (accelerometer , gyroscopes, depth cameras)
- 3-D trackers
- Data gloves
- Haptic feedback
- Foot controls
- Tangible user interfaces
- Digital paper

Pointing devices –gestures in virtual/augmented reality

LEAP MOTION

leapmotion orion

Comparison of pointing devices

- Many studies have consistently shown the merits of the mouse over alternative devices for speed and accuracy.
- The pointing stick has been found to be slower than the mouse due to tremors during fine finger movements (Mithal and Douglas, 1996).
- Trackballs and touchpads fall somewhere in between.
- Users' tasks matter when comparing devices.
- Users with motor disabilities often prefer joysticks and trackballs over mice, as the location of such devices remains fixed.

Fitts's law

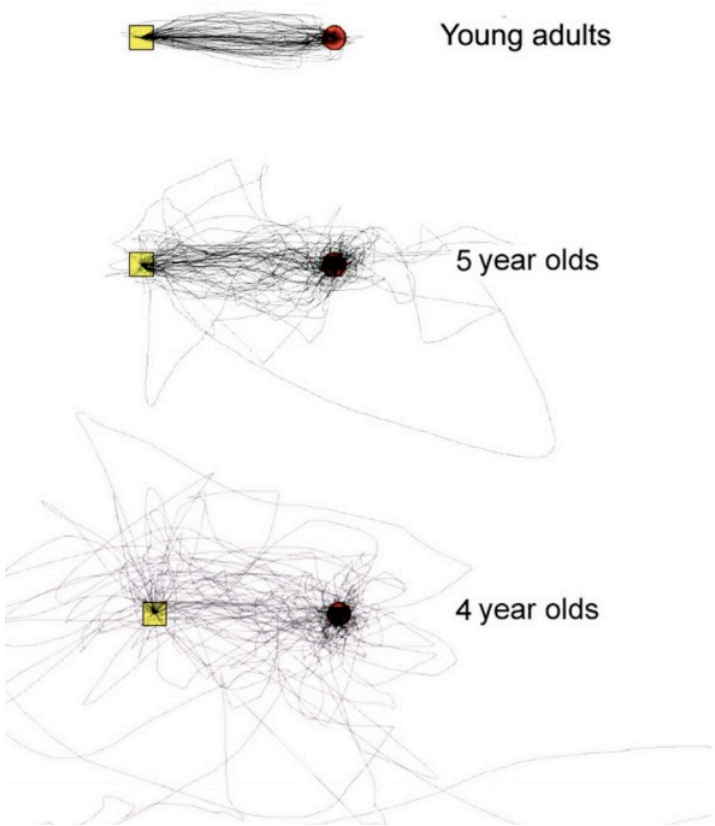
- One of the few scientific models of human-computer interaction is Paul Fitts's (1954) law of human hand movement.
- Fitts noticed that the time required to complete hand movements was dependent on the distance users had to move, D, and the target size, W. The movement time MT was found to be a function of D, W:

$$\mathbf{MT = a + b \log_2(D/W + 1)}$$

- where **a** approximates the start/ stop time in seconds for a given device and **b** measures the inherent speed of the device. Both a and b need to be determined experimentally for each device. MacKenzie (2013)

Fitts's law extensions

- Fitts's law applies to adults, however there is a lot of difference of human hand movement for children (Hourcade et al., 2004).



- An extension to the original law has been proposed for precision pointing movement time for high precision displays:

$$MT = a + b*\log_2(D/W + 1) + c*\log_2(D/W)$$

Displays

The display is the primary source of visual feedback to users from the computer.

It has many important characteristics:

- Physical dimensions (usually the diagonal dimension and depth)
- Resolution (the number of pixels available)
- Number of available colors and color correctness
- Luminance, contrast, and glare
- Power consumption
- Refresh rates (sufficient to allow animation and video)
- Cost / Reliability / Portability
- **Technologies**: In the past the main technology for displays was cathode-ray tubes (CRTs), now it is liquid-crystal displays (LCD), or light-emitting diodes (LEDs), or Organic light-emitting diodes (OLEDs) that can be laid on flexible plastic or metal foil.

example of foldable OLED display

Display example: Amazon kindle

- **Screen:** 6-inch **E Ink Carta**, built-in light, 300ppi, optimized font technology, 16-level gray scale
- **Dimensions:** 167 x 116 x 8.18 mm
- **Weight:** 6.4 ounces (Wi-Fi) or 6.8 oz (LTE version)
- **Storage:** 8 GB or 32 GB
- **Battery Life:** 6 weeks, based on a half hour of reading per day with wireless off, light setting = 13
- **Connectivity:** Wi-Fi only or Wi-Fi with LTE; Bluetooth
- **Supported ebook formats:** Kindle Format 8 (AZW3), Kindle (AZW), TXT, PDF, unprotected MOBI, PRC natively; HTML DOC, DOCX, JPEG, GIF, PNG, PMP through conversion; Audible audio format (AAX)
- **Waterproofing:** IPX8 water resistance rating, can withstand immersion in 2 meters of fresh water for 60 minutes

(http://www.amazon.com/)

Large Displays

Users discussing and pointing at details on the Stony Brook University Reality Deck (Papadopoulos et al., 2014), an immersive giga-pixel display consisting of 416 thin-bezel L CD displays and powered by 18 graphics workstations connected using a high-speed network (https://labs.cs.sunysb.edu/labs/vislab/reality-deck-home/)

Large Display example

Two users collaboratively control a lens on a gigapixel image of Paris, France using a tablet touchscreen as well as an interactive cursor (Chapuis et al., 2014)

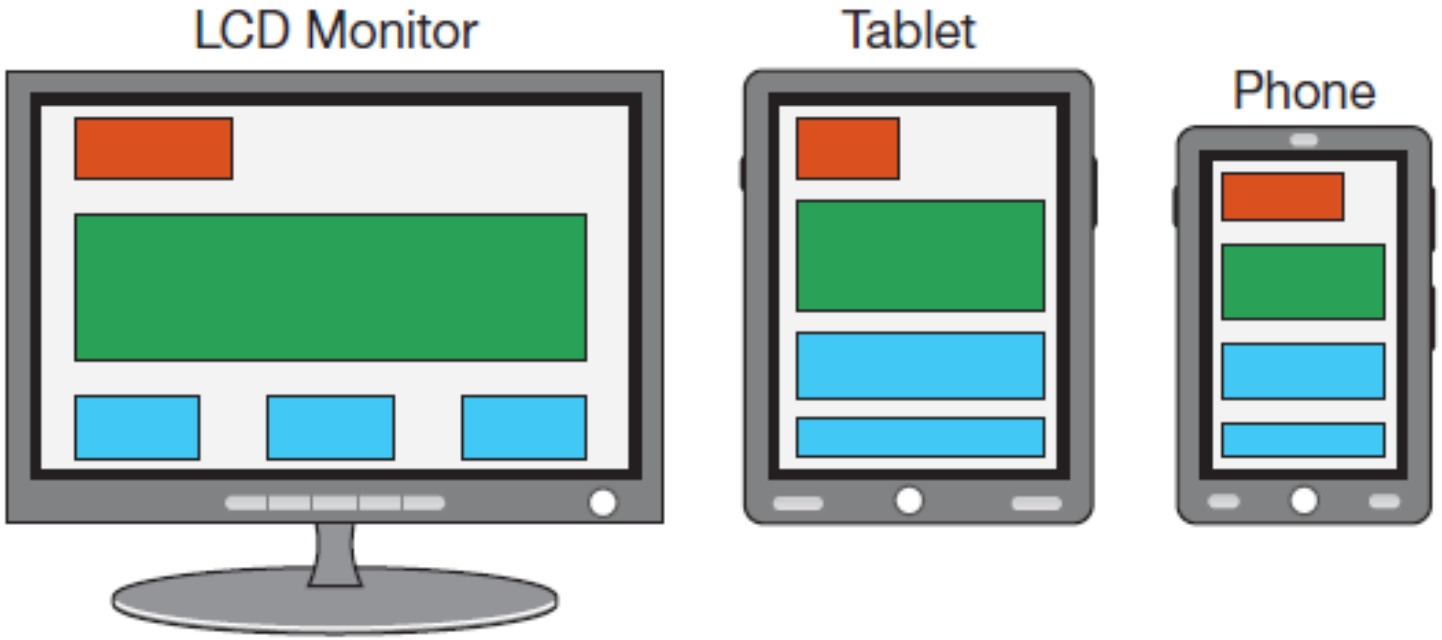
Tabletop displays

- Two people collaborating on a real estate task using a tabletop display and mobile table
- The tabletop serves as a shared and public display where changes affect all collaborators, whereas the tablet is perceived as a private display that allows users to work independently (McGrath et al., 2012)

Small Displays examples

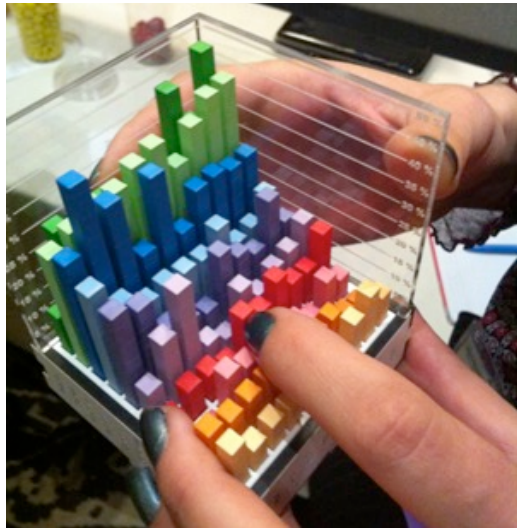
- The Apple Watch on the left supports both fitness as well as personal information management applications, such as email, calendar, and electronic payment
- The Fitbit Surge smartwatch on the right is designed mainly for personal fitness applications, and contains a step counter, heart rate monitor, and GPS

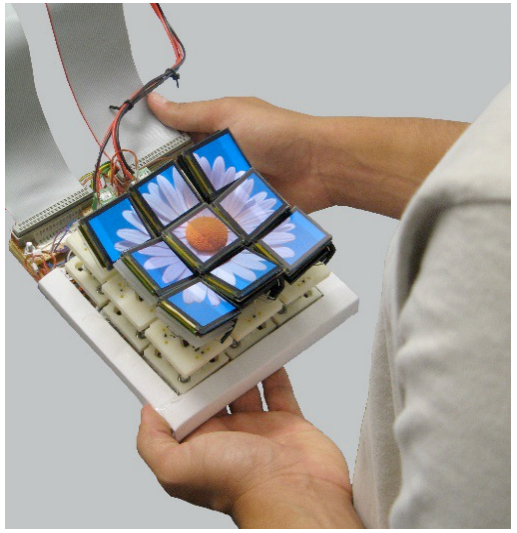
Responsive Design



The monitor layout on the left is automatically adapted to the smaller display space of a tablet (middle) and a smartphone (right).

Deformable and shape-changing display examples





- The left image shows a physical bar chart visualization displaying complex data (Jansen et al., 2013)
- The middle shows the tilt display that consists of multiple small displays mounted on actuators (Alexander et al., 2012)
- On the right is the PaperPhone, a flexible smartphone prototype that supports bending interaction (Lahey et al., 2011)

Communication and Collaboration

Topics

1. Introduction
2. Models of Collaboration
3. Specific Goals and Contexts
4. Design Considerations

Introduction

- The intrinsically motivating role of interpersonal connectedness (Deci and Flaste, 1995) drives human beings to want to communicate and interact with others across the full range of experiences.
- Constant and immediate communication and interaction with family, friends, collaborators, colleagues, coworkers, and even pets is now commonplace in the increasingly networked world!
  - Social networks have become part of our daily lives
  - Communication and collaboration tools shape the ability to work and accomplish shared goals with one another
- Design for these systems can be more complex than single-user interfaces because of its far-reaching, networked, and social aspects
  - Designers need to consider the downsides and negative sides of such systems

Social network/communication platforms

Smart phone users use multiple modalities for communication and social interaction, texting, voice, video calls, email, social media applications (Smith and Page, 2015). Social media platforms include:

- **Facebook**, the largest social networking site, around 1.6 billion active users

- **Instagram**, the fastest growing social network, mostly for sharing photos and videos

- **Twitter**: social networking site that enables posting of short text messages

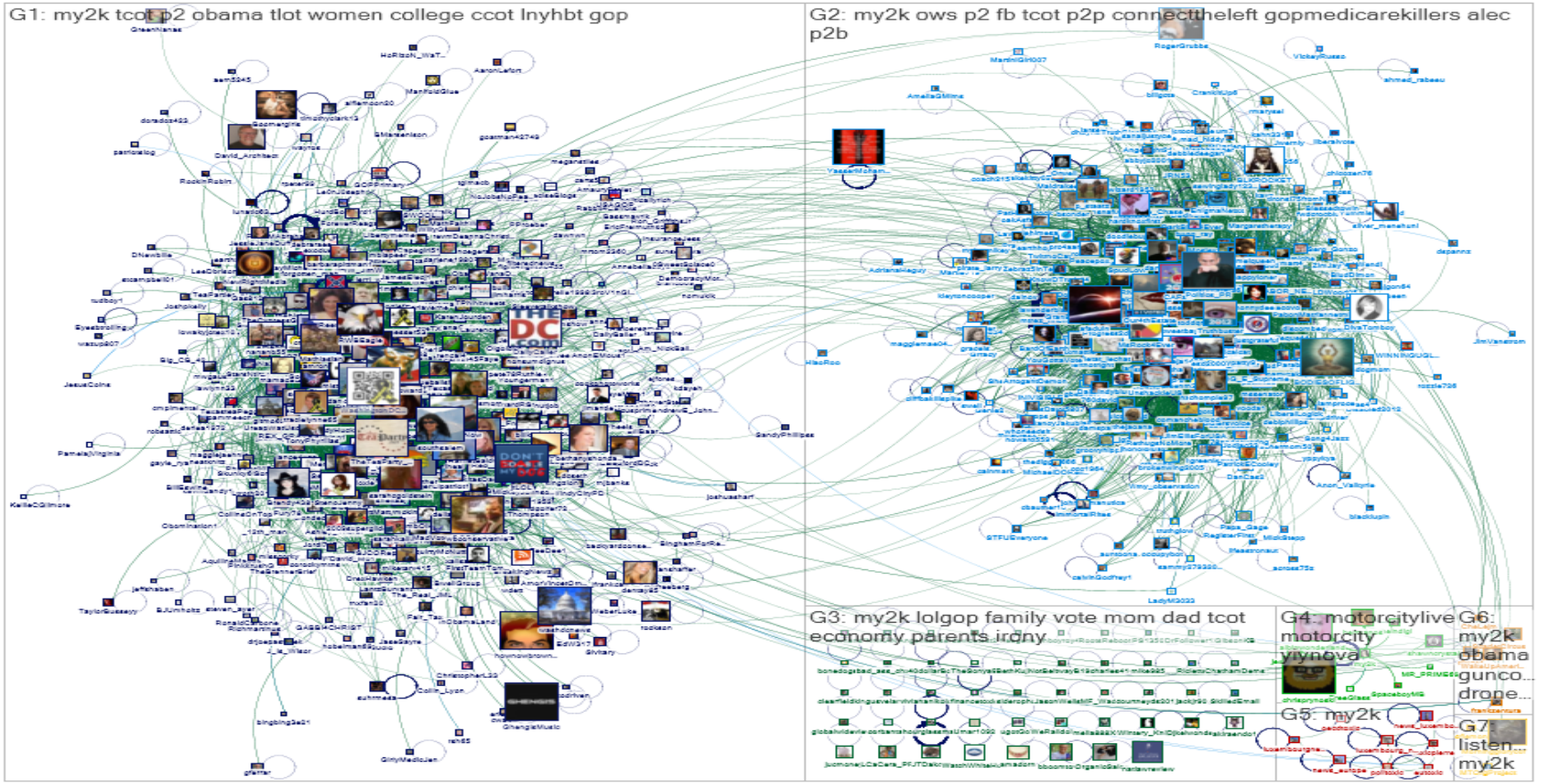
- **Skype**: Communication-based social networking platform, other similar platforms include: **Viber**, **WhatsApp**, **WeChat** (China), **QQ** (China)

Research in social/ collaborative systems

- **Content analysis methods** can be used to analyze and create typologies of the types of messages that individuals post, leading to insights not only about content but also about the relationships between individuals (Riffe et al., 2013).
- Also, studying communication platforms at scale requires that methods in **data science** be adapted . Communication texts, including chat logs, tweets, Facebook posts, and online comments can be analyzed using **natural language processing** (NLP) algorithms.
- These methods are useful for identifying, counting texts (Diakopoulos, 2015), such as according to **positive or negative sentiments** expressed.
- Text analysis can also be combined with structural understanding using methods from **social network analysis** (Hansen et al., 2011; Leetaru, 2011).
- Questions of **ethics** become paramount when studying open communication networks

Example of network research

Topical network maps have identified structures in online Twitter groups like polarized crowds, tight crowds, brand clusters, community clusters, and broadcast or support networks.



A network map made with NodeXL software shows the polarized nature of the conversation on Twitter around the #My2k hashtag that emerge over U.S. budget struggles in 2012 https://nodexlgraphgallery.org/Pages/Graph.aspx?graphID=2272

Examples of social activities

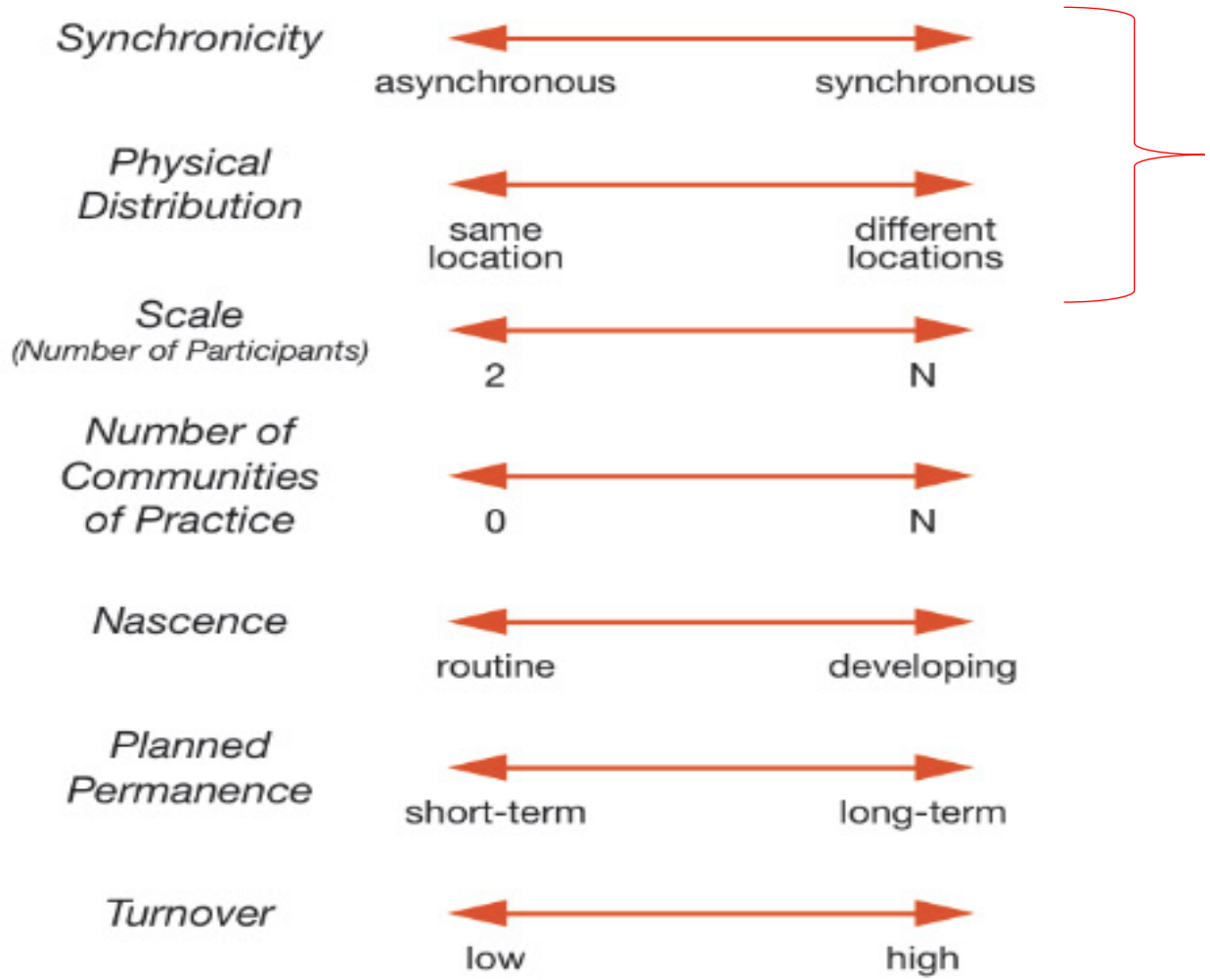
- Consider a typical day for a digital native:
  - wake up
  - check **social networking accounts** to get the latest news
  - go to work and **collaboratively edit** a report
  - **chat with an office colleague** about the new intern
  - **post a question to a Q/A site** about a statistical test needed to complete the report
  - on the way out of the office **text message a significant other** to coordinate dinner plans
  - after dinner **receive a crowd-based recommendation** for a movie to watch
- Each of these activities is related to communication/collaboration
- Discuss these daily activities. What are their differences and similarities?

time/ space matrix of collaboration

	synchronous	asynchronous
co-located	same time and place (e.g., shared table display)	different time, same place (e.g., public display)
remote	same time, different place (e.g., teleconferencing)	different time, different place (e.g., e-mail, discussion forums)

The binary time/space matrix is oversimplification: for instance, in terms of time, modern communication tools like Slack or Facebook blur the line between synchronous messaging and synchronous chat and are not distinctly asynchronous or synchronous.

Dimensions of the model of Coordinated Action (MoCA), [Lee and Paine, 2015]

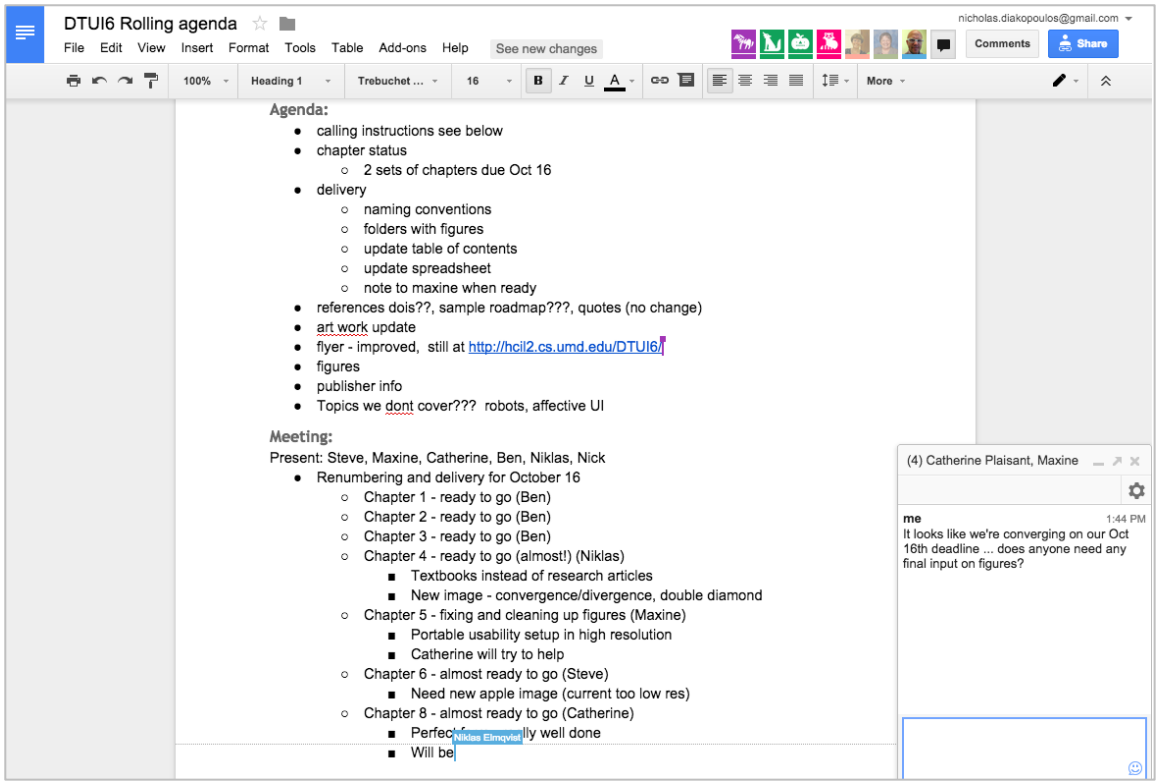


time/ space matrix dimensions

1. Synchronicity

- Coordinated actions can take place along a spectrum of synchronicity, ranging from actions that are entirely asynchronous to those that are entirely synchronous.
- Importantly, this dimension allows for actions to be a mixture of synchronous and asynchronous rather than enforcing a distinct boundary between extremes.
- In ongoing work processes, a larger context of asynchronous interaction often embeds episodic synchronous activity (Olson and Olson, 2000).
- The degree of synchronicity of a channel (i.e., the delay between turns) can also be a function of its context of use or social expectations.
- Many tools contain a mixture of asynchronous and synchronous communication and allow users options.

Synchronicity: example of mixed modes

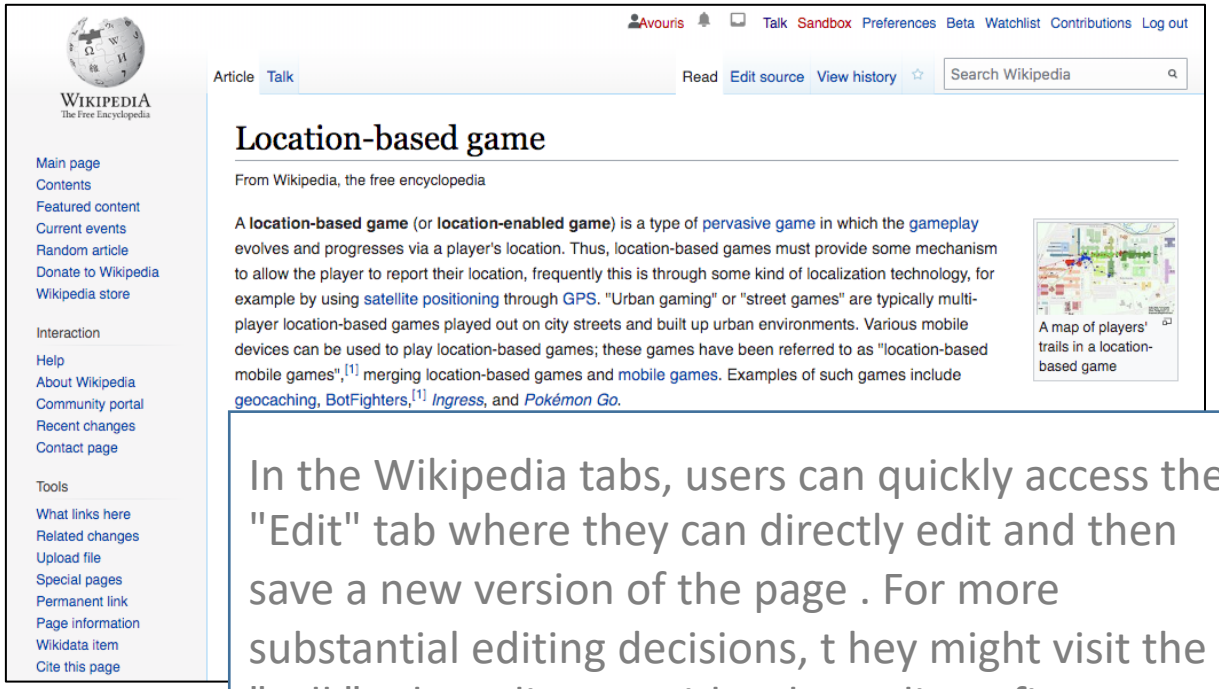


- the Google Docs interface showing how multiple users can simultaneously be editing a document
  - Note that colored flags for different users offer concrete feedback that signals who is editing a particular part of the document
  - In the lower right corner a chat box invites users to synchronously converse with each other around the document

2. Physical distribution

- Teams working together can exist along a continuum ranging from being at the same shared desk to the same room, building, campus, city, country, continent, or planet.
- Despite all of the internet communication channels available to users, the actual physical distribution of collaborators still matters (Olson and Olson, 2000).
- It is difficult to schedule synchronous communications that are convenient to all parties: a 5 p.m. call in Norway is an 8 a.m. call in California, probably not convenient for either party. Who on the team deserves to be more inconvenienced in case a common time cannot be found?

3. Scale
[2 → ← N]



In the Wikipedia tabs, users can quickly access the "Edit" tab where they can directly edit and then save a new version of the page . For more substantial editing decisions, t hey might visit the "Talk" tab to discuss with other editors first.

- Scale of collaboration = number of participants involved.
- The difference is substantial between co-writing a paper with one other person and contributing to a Wikipedia article with many others.
- Hierarchical task decomposition, integration of work, and quality over sight have been explored in large-scale collaborations like crowdwork (Kittur et al., 2013). As efforts scale, the role of leadership and expertise becomes apparent in ensuring a successful outcome (Luther et al., 2010).

4. Number of communities of practice [0 → ← N]

- A community of practice refers to the idea that over time individuals form a group as they teach and learn from one another and develop coherent values, norms, and practices (Wenger, 1998).
- Different communities may have different goals or notions of impact, different standards, or different toolsets that reflect disciplinary educational patterns.
- A group may consist of a single community of practice, or a huge diversity of people in the world that may come together from various disciplines, ways of working, language, and culture to collaborate.

5. Nascence [routine → ← developing]

- Nascence refers to the degree to which coordinated actions are already established and routine or if they are un-established, new, and developing.
- Research has shown that the characteristics and behaviors of founders early in a group's lifespan predict how long it will survive (Kraut and Fiore, 2014). Actions like visiting the group frequently, having multiple group administrators, and articulating a group description and logo during the group's most nascent stage (i.e., the first week) predicted group survival.

6. Planned permanence
[short-term long-term]

- Some coordinated actions are shorter-term, whereas others are longer -term.
- For instance, responding to a crisis event may take place over the course of hours, days, weeks, months, or even years, and it may be apparent at the outset based on the magnitude of the response needed
- Regardless of degree of permanence, the participants will need to develop shared vocabulary and coordinate work practices and output.

7. Membership turnover
[low → ← high] (number of people entering/ leaving)

- Turnover refers to the stability of the people involved in a collaboration in terms of how frequently new participants enter and leave the group.
- High inflow of new contributors can pose difficulties to developing policies and behavioral expectations and norms for the group.
- One design approach toward this issue is to give users badges that indicate their tenure within the community or that otherwise mark them as "verified“ or "trusted"

Community Budges

- badges used in the DUST alternate reality game (http://fallingdust.com) to signal different achievements during collaborative play.

- Badges used by the Huffington Post until mid 2014 indicated both roles and levels of activity

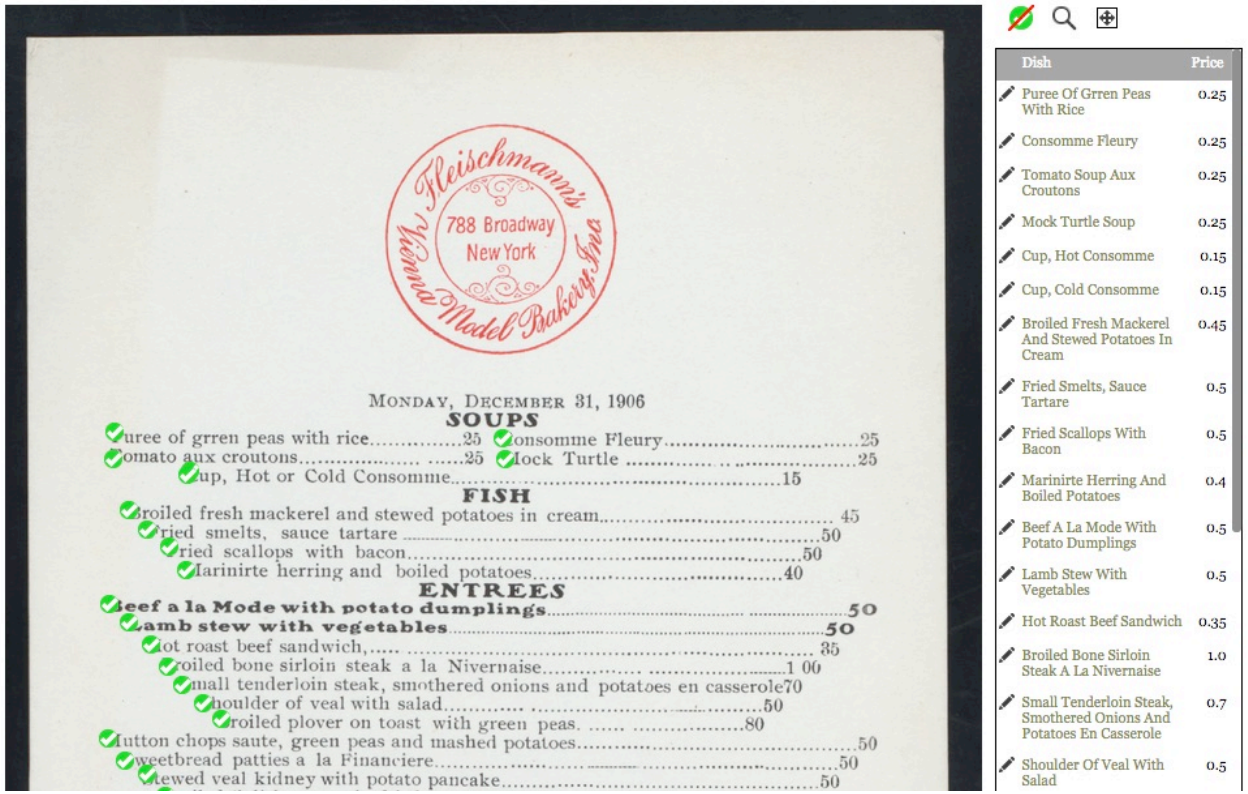
Motivation of collaboration

- People collaborate because doing so is satisfying or productive
- Collaboration allows individuals:
  - To get the emotional rewards of socializing and interacting with others
  - To accomplish greater goals than they could alone
  - To meet and transact with people that they otherwise could not

Specific domains and contexts

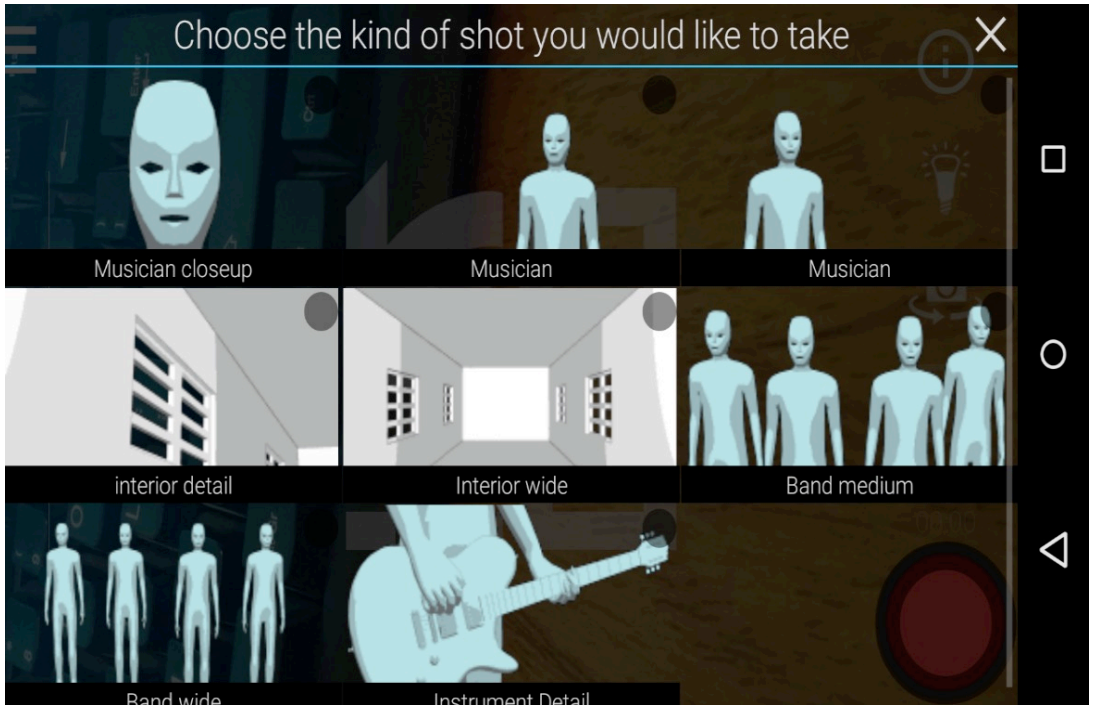
- Communication and Conversation, e.g. SnapChat
- Online Markets, e.g. eBay
- Meeting Coordination, e.g. meetup
- Creative Production, e.g. GitHub version control
- Crowdsourcing and Crowdwork, e.g. restaurant reviews, e.g. sites to hire contractors
- Entertainment and Gaming, e.g. Massive Multiplayer Online Role-Playing Games (MMORPG)
- Education, e.g. Massive Open Online Courses (MOOC)

Example of crowdsourcing



Historical 1906 menu from Fleischmann's Bakery digitized by the New York Public Library in collaboration with thousands of crowdsource volunteers who helped type in individual menu items. Note the UI list at right reflects and allows for navigation of items to be digitized
http://menus.nypl.org/menu_pages/5247

Entertainment and gaming example



The **Bootlegger** app allows users to coordinate the creative production of videos around live events

Design Considerations

- Cognitive Factors
  - Common Ground
  - Social Cues
  - Activity Awareness
  - Interruptions
- Individual Factors
  - Privacy
  - Identity
  - Trust and Reputation
  - Motivation
  - Leadership
- Collective Factors
  - Deviance
  - Moderation
  - Policies and Norms

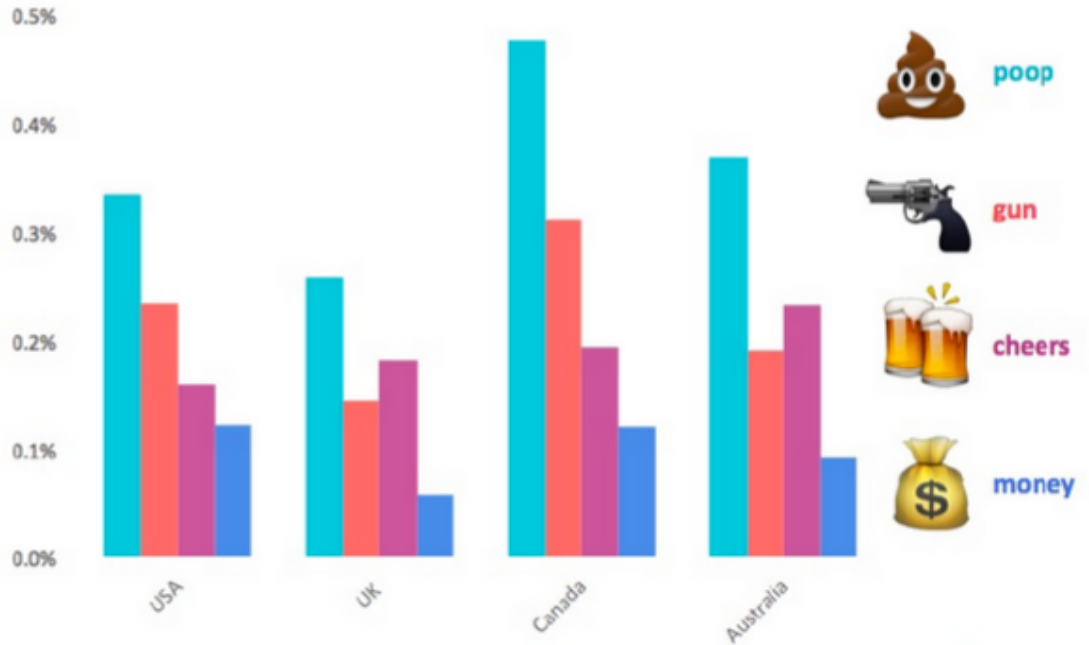
Common ground

- Establishing common ground - the knowledge that communicators have in common - as well as jointly understood references during communication can be essential for effective collaboration. What do users mean when they say "this button" or "that menu"? (deictic references)
- In designing communication systems, it's worthwhile to consider the nature of the tasks that need to be accomplished and how different forms of referencing may need to be supported in order to make those tasks efficient - or indeed possible at all.

A tweet on Twitter can embed references in several ways, including referencing another person's account (i.e. @FILWD) as well as referencing and quoting another person's entire tweet, providing vital context and citation for the information

Social cues

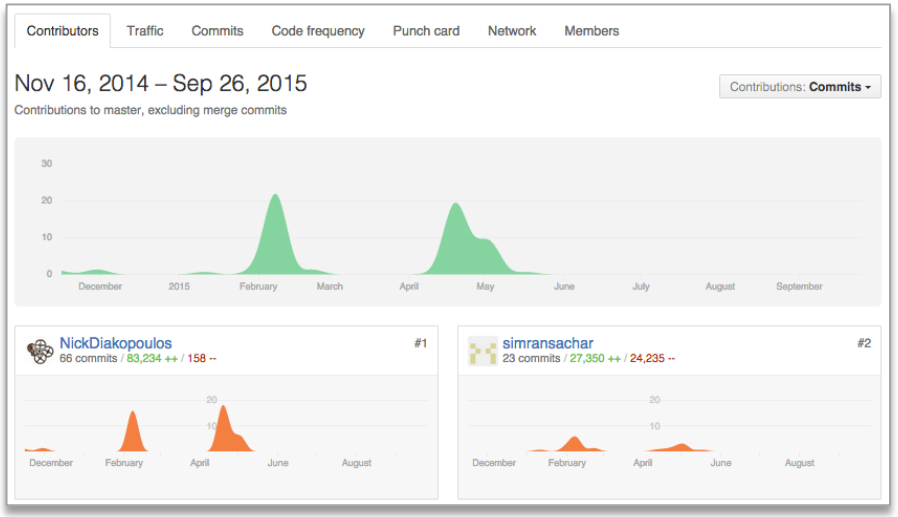
Beyond reference, there are a variety of other **nonverbal cues** that can also enhance communication, including facial expressions, gaze direction, posture, proximity, and bodily orientation (Baym, 2015). e.g. emojies



Emoji use varies across cultures even users of the same language
http://www.scribd.com/doc/262594751/SwiftKey-Emoji-Report

Activity awareness

- The notion of **social translucence** argues that making social behavior visible facilitates awareness and ultimately accountability for one's actions (Gilbert, 2012).
- This might include making visible information such as "who sees what,“ "who's done what," and "who knows that I know."
- For instance, collaborators often need to maintain an understanding of what others have accomplished in a joint work activity around shared artifacts (Olson and Olson, 2013). through alerts and other interface signals.



- A GitHub dashboard charting project activity over time and indicating two users who are active in the project including their overall coding activity as well as volume over time
- More details on activity are available by drilling into individual users

Interruptions

- Interruptions in or by communication channels can affect their usability.
- Research has examined the design space of interruptions and articulated various dimensions such as the symmetry of interruptions, the obtrusiveness (e.g., focal or peripheral), and the temporal gradient (e.g., historical, current, or predicted availability) among others (Hincapie- Ramos et al., 2011).
- Where a communication technology fits within this design space will affect how users integrate it into their workflow.

Privacy

- One of the issues that arises in conjunction with greater activity awareness is the concomitant loss of privacy.
- If activity is collected implicitly based on actions within the system-rather than explicitly recorded or set by the user – this could affect the use or adoption of the system, as users may not want others to see every little action they take.
- User s' privacy may be violated because of algorithmic inferences that can predict a range of sensitive personal information like sexual orientation, personality trait s, ethnicity, and mental health (Lee, 2014).
- When designing communication systems, it's important to consider situations or contexts in which users may want different amounts of privacy and to offer some degree of control, adaptability, or facility to opt out.

Identity

- Online communities open up the question regarding how people represent and portray themselves when people's physical bodies are not shown, when text or avatars become the primary medium of communication.
- In an online game like World of Warcraft, an older man could play the character of a young woman, or a teenager could role-play as an aged magician.
- The disinhibition afforded by anonymity, while it can lead to crude and anti-social behaviors and cue de-individuation and mob behavior, may also contribute to experimentation and creativity (Bernstein et al., 2011).
- Moreover, anonymity in online communication can reflect legitimate human needs, such as share sensitive personal health information.

Trust and reputation

- Reputation is related to identity, and concerns the ability to develop a sense of trust.
- Trust is defined as a reliance on a piece of information (or a person) and is particularly important in marketplace contexts where goods or services may be sought or exchanged.

- A user page on Yelp (online listing service) showing a variety of social activity context including volume of activity like reviews and photos, an “elite” badge, a graph of ratings previously made, feedback on the user’s reviews including if they were useful, funny, or cool, and other compliments
- This rich information can help othersunderstand the reliability of this user

Motivation

- As in any interactive system, it is crucial to understand why people engage in collaboration and communication.
- There is a strong intrinsic motivation for interpersonal connectedness (Deci and Flaste, 1995), but there are many other reasons people also partake in and sustain interest in collaboration and communication, such as **altruism**, **reciprocity**, **reputation or status**, and **habit** (Preece and Shneiderman, 2009).
- One way to understand this is using the Uses and Gratifications framework (Ruggiero, 2000), which describes how and why active media consumers engage media in order to satisfy specific needs.
- The designers should understand and accommodate different motivations.

Leadership

- Leadership constitutes an ability to guide and direct a group's activities. It is complicated in online scenarios because it can be harder to maintain awareness of others' activities and to develop and maintain rapport and trust (Olson and Olson, 2013).
- For designers of systems that enable creative production or crowd work, c areful consideration should be given to how leaders can be empowered to initiate and lead groups, accomplish the other demands of managing group work, and maintain their motivation to continue in their role.

Collective factors: deviance

- Societies, cultures, and sub-cultures may have their own social norms for what constitutes acceptable behavior within that group, but when a member of a group violates a social norm it is considered a socially deviant action ("trolls", "flaming" (Lee and Kirn, 2015).
- Designers must be keen to consider various ways in which deviant behavior can be regulated or to make social norms more apparent and salient so that nonnormative behaviors are reduced and their impacts on the community lessened.

Moderation

- Given that deviant behavior is to be expected in some measure within online communities, one of the approaches to cope with the issue is to have moderators evaluate contributions and take various actions on the postings.

In the New York Times commenting system they mark some comments as **"Times Picks"** with a bright yellow badge, indicating it is an exceptional comment and signaling norms about what constitutes an interesting and valuable contribution to the comment thread.

Policies and norms

- Policies, rules, and norms can be important signals to users in online communities so that they know what constitutes acceptable versus unacceptable behavior and so that protocols for adjudication of moderation or other decisions are apparent.
- Knowing the etiquette for a given channel or community may not always be immediately apparent. Thus, policy documents are often posted in places where users can easily find them.
- example: on Reddit, a social commenting site, the Reddiquette for the site lists guidelines for behavior, useful for newcomers as well as existing users.

Design for collaboration & communication

- Communication and collaboration tools are continually evolving to support human experience.
- While there are many positive outcomes derived from using such tools, designers must also be aware that negative behaviors are possible and should be prepared to consider mitigating design alternatives.
- It is essential to understand the different contexts in which users may employ communication and collaboration systems from conversations to markets, meetings and creative work, entertainment, crowdsourcing, and education.
- Models such as MoCA can help in thinking through these various contexts during the design process.

Resources

Social media data collection tools

http://socialmediadata.wikidot.com/