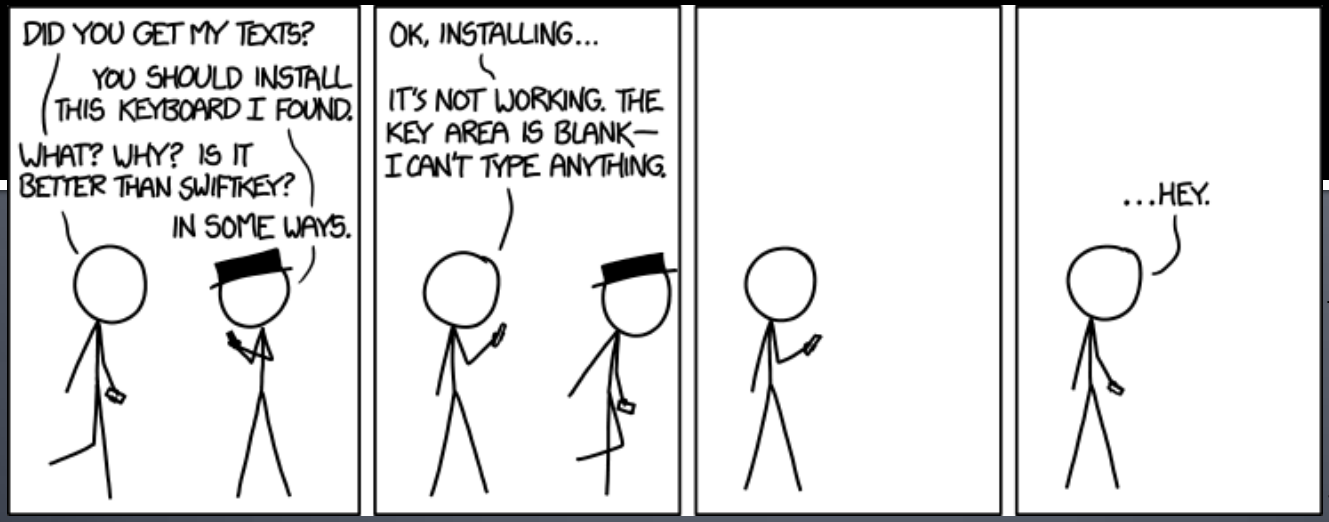
Prototyping Input Methods on Touch Devices:
Our experience and examples

IUC38: Touch the Future



http://xkcd.com/1284/

Introduction

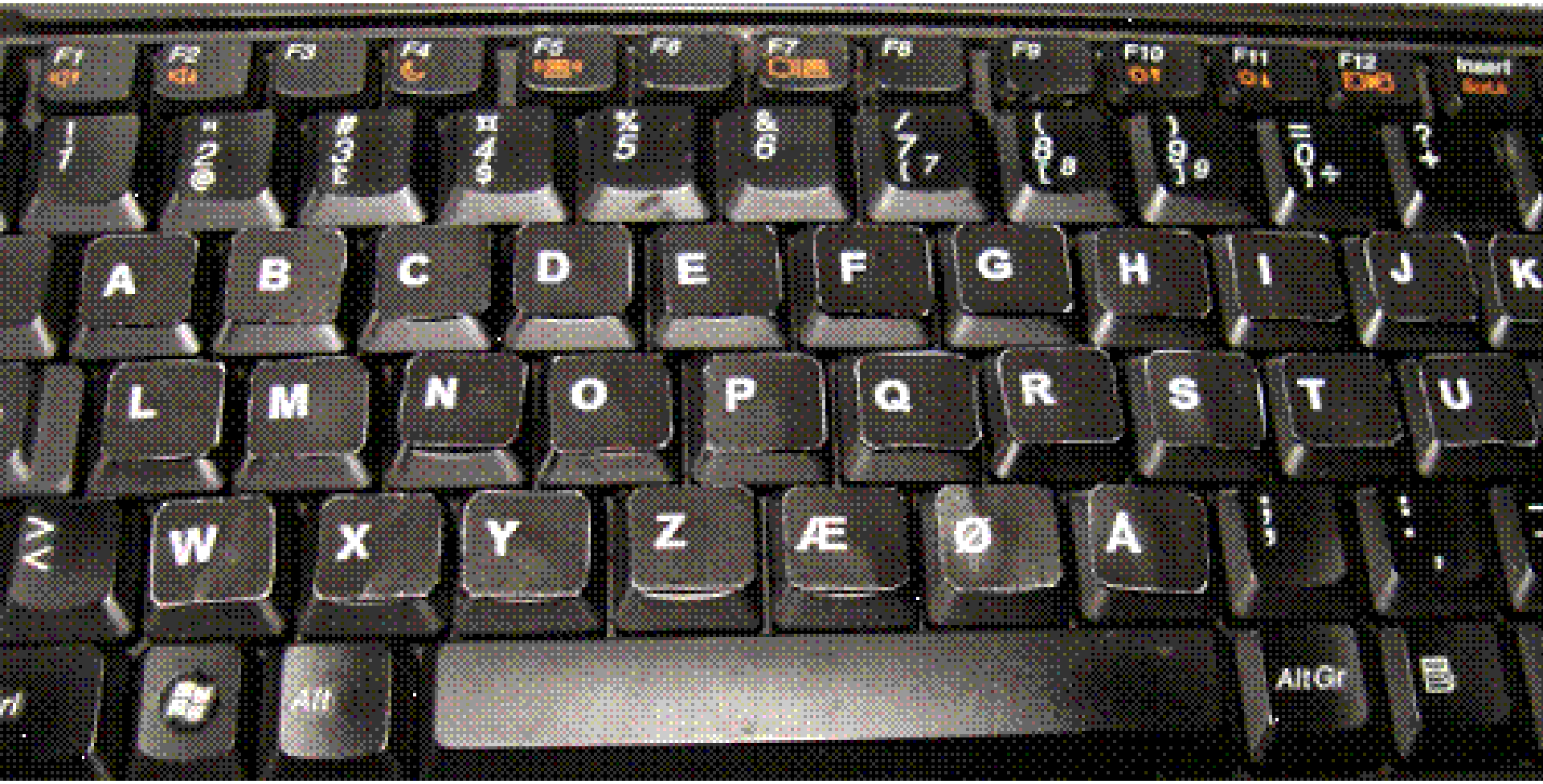
- Escaping our past
- Emerging markets and languages
- The DISCUS principles
- Keyboard prototypes

Escaping our past

- Is it possible to escape the legacy of teletype machines, typewriters, and keyboards?

- English:
  - Devices regularly released with non-QWERTY
  - A-Z, Dvorak, and esoteric layouts
  - T9 initially successful on tiny devices
  - But: market leaders now all use QWERTY

It’s a German QWERT¥Z – the grand daddy

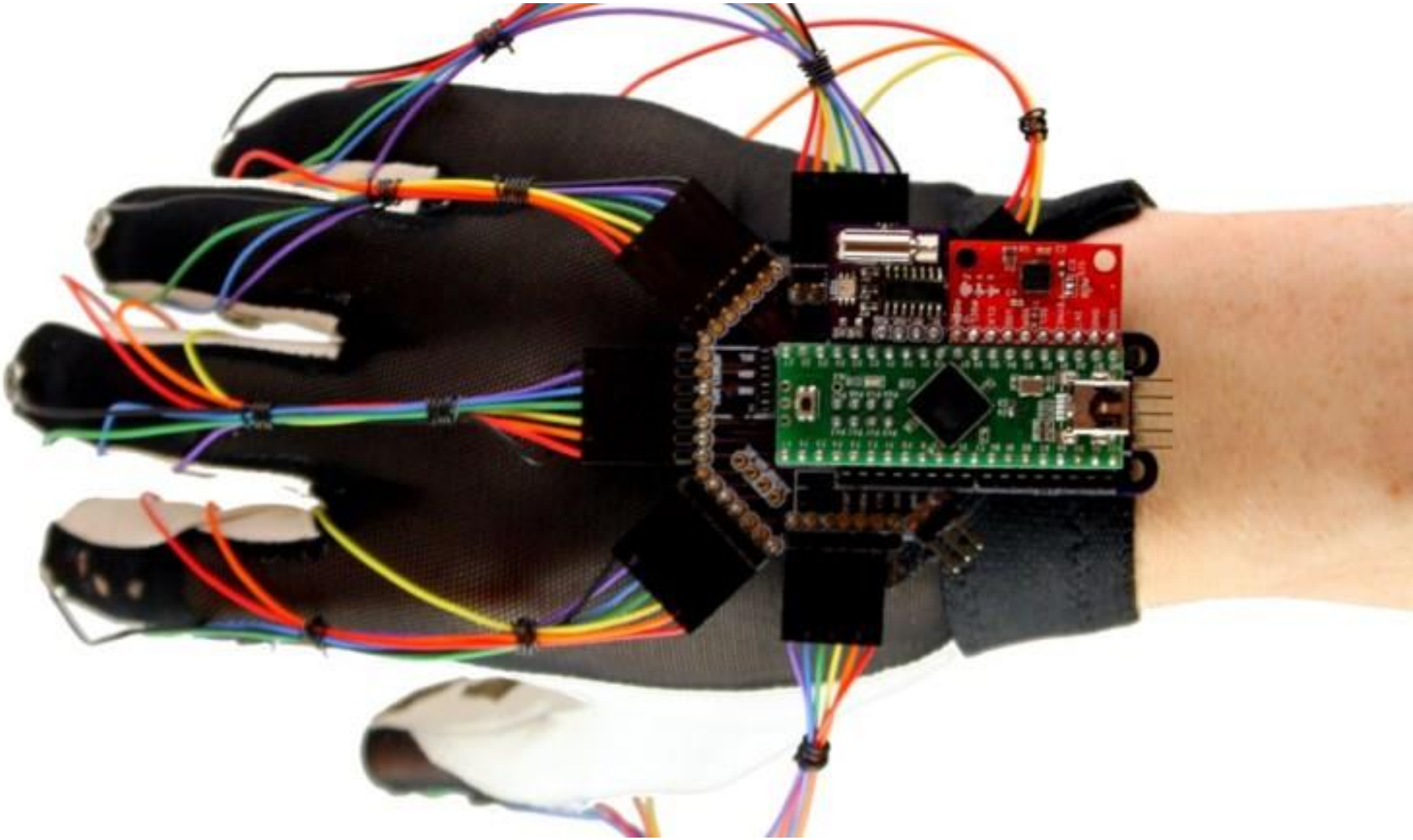


It’s not QWERTY. But is it usable?

http://www.iu.hio.no/~frodes/unitech10/022-Sandnes/index.html

As used by NSA – special Secret Code button

http://upload.wikimedia.org/wikipedia/commons/1/16/TI_SpeakSpell_no_shadow.jpg



No idea.

http://www.keyglove.net

T9 … not QWERTY … significant success http://conversations.nokia.com/2011/09/06/the-input-debate-why-im-true-to-t9-on-my-nokia-n8/

Optimus.

http://www.artlebedev.com/everything/optimus/

QWERTY with one less row. Clever.

http://www.blogcdn.com/www.engadget.com/media/2010/05/lgfathom111.jpg

It looks weird, but it's still QWERTY!

http://www.6byg.net/brain-coordination-using-dvorak-and-qwerty-keyboards/

It looks weird, but it's still QWERT!

http://c2.com/cgi/wiki?HalfQwerty

It looks weird, but it's still QWER... um... GT?

http://c2.com/cgi/wiki?HalfQwerty

Touch innovation – literally around the edges!

http://www.hardwarezone.com.sg/feature-hands-apple-iphone-6-6-plus-pictures-and-videos/when-it-coming-and-how-much-plus-more-photos

Do we want to escape our past?

- What do those images tell us?
- There are benefits to the status quo
  - Less for users to learn
  - Familiarity with input method reduces 'strangeness barrier'
  - Reduced technical support for input method
  - Faster to market

Emerging markets & languages

- Do they have an input method history?
- Major changes are possible
  - Japan moved to Romaji
  - China moved to Pinyin
- Can we do better than English?
- How can we optimise layout for acceptance?

The DISCUS Principles

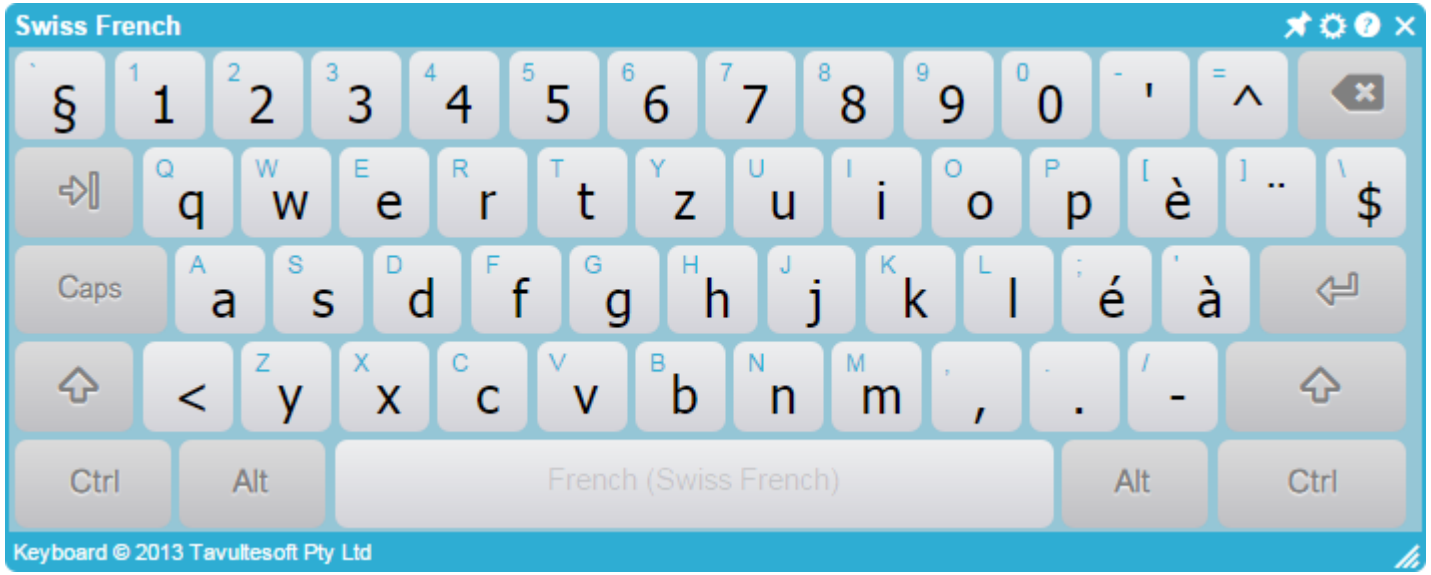
- Discoverability
- Intuition
- Simplicity
- Consistency
- Usability
- Standards

DISCUS – Discoverability

- Make it easy to find all letters
  - Even rare ones
- Reduce experimentation
  - Experimentation typical user experience today
  - Most English users never try typing accents
- Keyboards for languages with more characters than keys *are rarely obvious to a first time user*

DISCUS – Discoverability – Example

- Can you type É on Swiss-French keyboard?



DISCUS – Discoverability – Example

- Can you type É on Swiss-French keyboard?
- No, [Shift] + [é] won't work

- You have to type [Caps Lock], [é]

DISCUS – Intuition

- When iPhone was released, it felt 'magic' and 'intuitive' compared to other devices at the time
- Hard to quantify; you know it when you have it
- Examples:
  - Holding a key to show related characters
  - Double-tap shift key to engage Caps Lock
  - Sliding from shift key to letter key for upper case
  - Double-space signifies end of sentence and inserts a full stop automatically

DISCUS – Simplicity

- Temptation to include lots of extra characters
  - Inverse pressure to Discoverability
- Divorce encoding and input
  - ZWJ, ZWNJ, LRE and more! Great for geeks!
  - Composed, decomposed and other rotten characters
  - Input order vs encoding order

DISCUS – Simplicity

- Six characters on each key? Wonderful!
  - But too noisy for most users
- A keyboard doesn't need to do everything
  - We have a  key to switch keyboards
  - One keyboard per language
  - Specialized keyboards for specialized uses

DISCUS – Consistency

- How closely does your input method correspond to:
  - Orthographic conventions?
  - Phonetic – spoken word?
- Writing systems are typically neither consistent nor terribly logical
  - Yet scripts – even English – do have some internal consistency
  - Do you understand the script?

DISCUS – Consistency

- Understanding the structure of the script **key** to a good consistent design
  - Linguistic analysis
- Well-researched layouts are more successful
  - Many users will not have the level of understanding of the script required to design a good keyboard layout
  - However, they will intuitively feel that the keyboard works better for them

DISCUS – Consistency

- Questions to consider:
  - Is alphabetic order sensible?
  - Or group by sound?
  - Which letters are rare (frequency analysis)?
  - Common sequences & pairs?
- Frequency Analysis (Dvorak, Colemak?)
  - Small touch devices reduce benefit

DISCUS – Usability

- Keyboard design may look amazing on paper
- Great concepts often feel awkward in practice
- Test is only way to be sure
  - Experienced users … and novice users
  - Native speakers … and foreigners

DISCUS – Usability

- Usability Rules of Thumb
  - Minimize animation and visual effects
  - Number of rows: 4 – 5 (phone – tablet)
  - Number of keys per row: 10 – 13
  - Control keys: don't move or resize across layers
  - Layer keys: toggle back to previous layer

DISCUS – Standards

- Unicode
- Legislated and societal requirements:
  - Accessibility laws
  - Mandated characters (e.g. currency symbols)
  - Consistency with existing layouts (e.g. INSCRIPT)
- Consider cross-device experience

Prototype Layouts

- Conceptual Layouts

- Ignore *Standards* in experiments: DISCUS

- Lao Syllabic
- Thai Satellite
- Amharic Fidelity

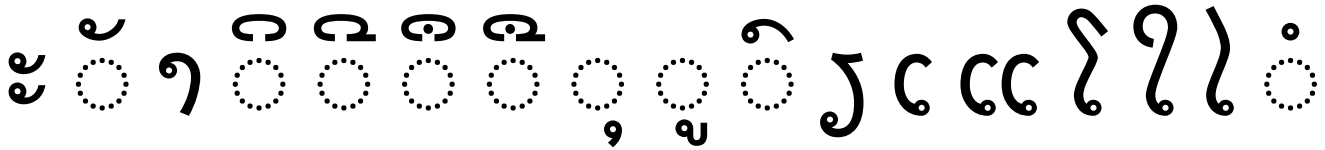
Lao Consonants

- Modern Lao is very regular and allows optimised input with knowledge of allowable combinations.
- 27 consonants (1 rare)

ກ ຂ ຄ ງ ຈ ຊ ຍ ດ ຕ ຖ
ທ ນ ບ ປ ຜ ຝ ພ ຟ ມ ຢ
ຣ ລ ວ ສ ຫ ອ ຮ

Lao Vowels

- 19 vowel symbols



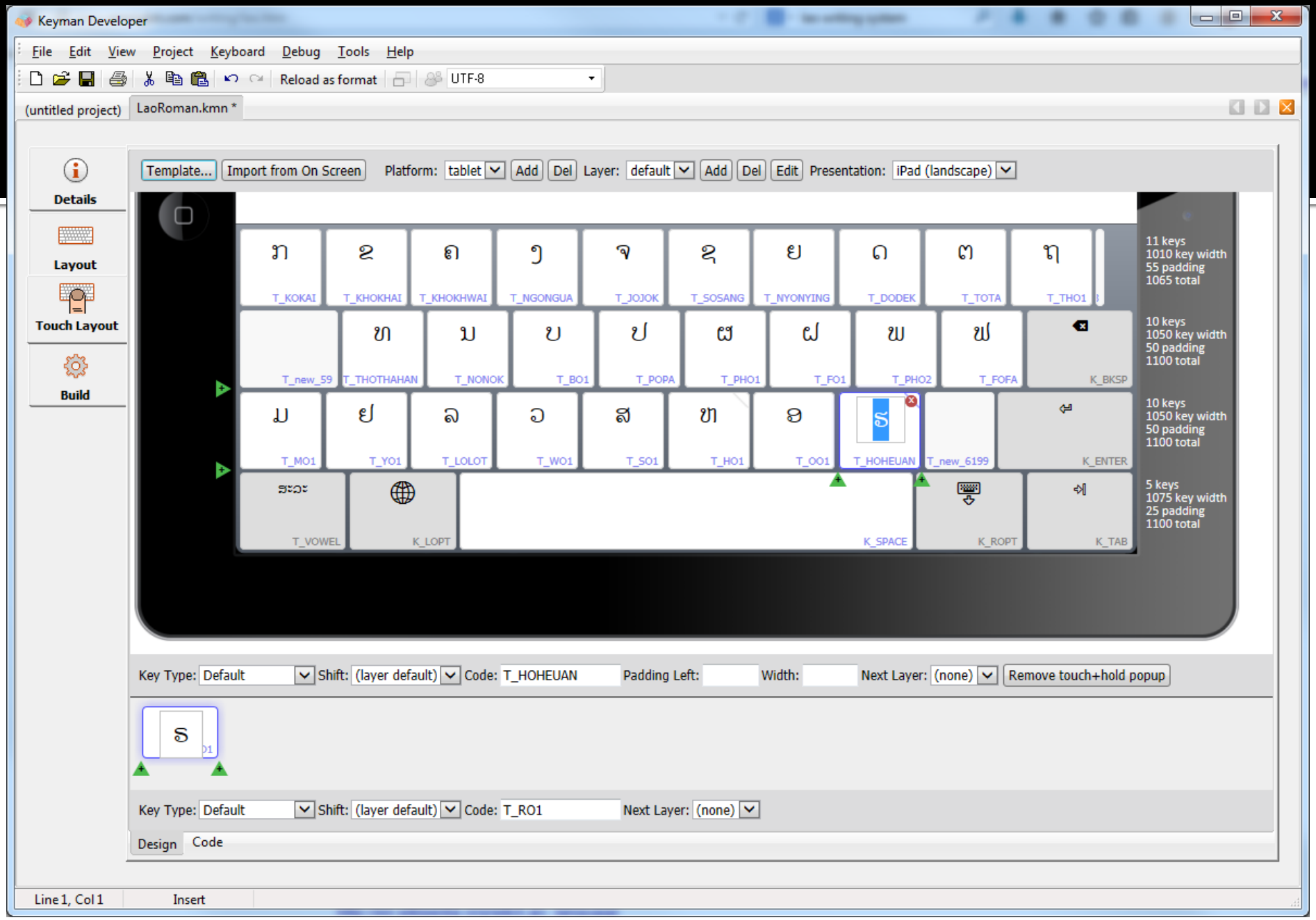
ວ and ອ are consonant and vowel

- Vowel symbols combined to form 39 vowels. 25 open syllable vowels.

Lao Tones and Marks

- 4 tone marks – 6 spoken tones
- A few other marks.

- A Consonant-Vowel-Consonant-Tone syllable-based input method is achievable.


Keyman Developer
File Edit View Project Keyboard Debug Tools Help
Reload as format
UTF-8
(untitled project)
LaoRoman.kmn *
Details
Layout
Touch Layout
Build
Template...
Import from On Screen
Platform: tablet
Add
Del
Layer: default
Add
Del
Edit
Presentation: iPad (landscape)
T_KOKAI
T_KHOKHAI
T_KHOKHWAI
T_NGONGUA
T_JOJOK
T_SOSANG
T_NYONYING
T_DODEK
T_TOTA
T_THO1
11 keys
1010 key width
55 padding
1065 total
T_new_59
T_THOTHAHAN
T_NONOK
T_BO1
T_POPA
T_PHO1
T_FO1
T_PHO2
T_FOFA
K_BKSP
10 keys
1050 key width
50 padding
1100 total
T_MO1
T_YO1
T_LOLOT
T_WO1
T_SO1
T_HO1
T_OO1
T_HOHEUAN
T_new_6199
K_ENTER
10 keys
1050 key width
50 padding
1100 total
T_VOWEL
K_LOPT
K_SPACE
K_ROPT
K_TAB
5 keys
1075 key width
25 padding
1100 total
Key Type: Default
Shift: (layer default)
Code: T_HOHEUAN
Padding Left:
Width:
Next Layer: (none)
Remove touch+hold popup
Key Type: Default
Shift: (layer default)
Code: T_RO1
Next Layer: (none)
Design
Code
Line 1, Col 1
Insert


T_KOKAI T_KHOKHAI T_KHOKHWAI T_NGONGUA T_JOJOK T_SOSANG T_NYONYING T_DODEK T_TOTA T_THO1
T_new_59 T_THOTHAHAN T_NONOK T_BO1 T_POPA T_PHO1 T_FO1 T_PHO2 T_FOFA K_BKSP
T_MO1 T_YO1 T_LOLOT T_WO1 T_SO1 T_HO1 T_OO1 T_HOHEUAN T_new_6199 K_ENTER
11 keys 1010 key width 55 padding 1065 total
10 keys 1050 key width 50 padding 1100 total
10 keys 1050 key width 50 padding 1100 total
5 keys 1075 key width 25 padding
T_A T_E T_EA T_I T_UE T_U T_O T_O1 T_OE T_AM
T_AA T_EE T_AE T_II T_EU T_UU T_OO T_OH T_ER K_BKSP
Initials T_INITIAL T_UA T_EUA T_IA T_AO T_AY T_AI T_new_4100 K_ENTER
Finals T_FINALS K_LOPT Tones T_TONE K_SPACE K_ROPT K_TAB
11 keys 1018 key width 82 padding 1100 total
10 keys 1030 key width 70 padding 1100 total
10 keys 1050 key width 50 padding 1100 total
6 keys 1070 key width 30 padding 1100 total
T_new_696 T_KOKAI T_NGONGUA T_NYONYING T_DODEK T_NONOK T_BO1 T_MO1 T_WO1 T_new_756
T_new_702 T_new_703 T_new_704 T_MAIEK T_MAITO T_MAITI T_MAIJATAWA T_new_710 T_new_4994 K_BKSP
Initials
10 keys 1005 key width 95 padding 1100 total
10 keys 1030 key width 70 padding 1100 total
10 keys 1050 key width 50 padding
T_new_5523 T_new_5524 T_new_5525 T_new_5526 T_new_5527 T_new_5528 T_new_5529 T_new_5530 T_new_5531 T_new_5532
T_new_5538 T_new_5539 T_new_5540 T_MAIEK T_MAITO T_MAITI T_MAIJATAWA T_new_5545 T_new_5546 K_BKSP
Initials T_INITIAL T_new_5551 T_new_5552 T_new_5553 T_new_5554 T_new_5555 T_new_5556 T_new_5557 K_ENTER
Finals T_FINALS K_LOPT Tones T_TONE K_SPACE K_ROPT K_TAB
10 keys 1000 key width 50 padding 1050 total
10 keys 1030 key width 70 padding 1100 total
10 keys 1050 key width 50 padding 1100 total
6 keys 1070 key width 30 padding 1100 total

Lao Syllabic – Live Demo

- Live demo (Chrome)
  - ສະບາຍດີ - hello
    - ເມືອງ - city

Lao Syllabic – Challenges

- Extra keystroke to finish most syllables
  - This does not meet our *Intuition* bar
  - Spacebar mitigation: returns to consonant layer
    - Does not insert a space unless pressed a second time
- Support for irregular combinations
  - Loan words, archaic words, expat Lao
  - Switch layers manually

Thai Satellite – Thai

- Thai closely related to Lao
  - Fewer orthographic reform cycles

- 44 consonants
- Over 50 vowels
- Complex spelling

- Slightly different approach required

Thai – Standard vs 'Satellite'

- Standard:
  - Typewriter
  - Small keys
  - 5 rows
- Prototype
  - Common consonants
  - Larger keys
  - 4 rows

Thai Satellite – Approach

- Constructing a syllable around the base letter.
  - Neither orthographic nor phonetic, but a comfortable compromise.
- Keyboard dynamically reorders backing store as it constructs the syllable
- Hides rare consonants under related base consonant
- Similar approach in Apple's Kana keyboard.

Thai Satellite – Live Demo

- Live demo

- แม่น้ำ – river
- นี่ vs นี้ – this vs now.
- เมือง – city

Thai Satellite – Advantages

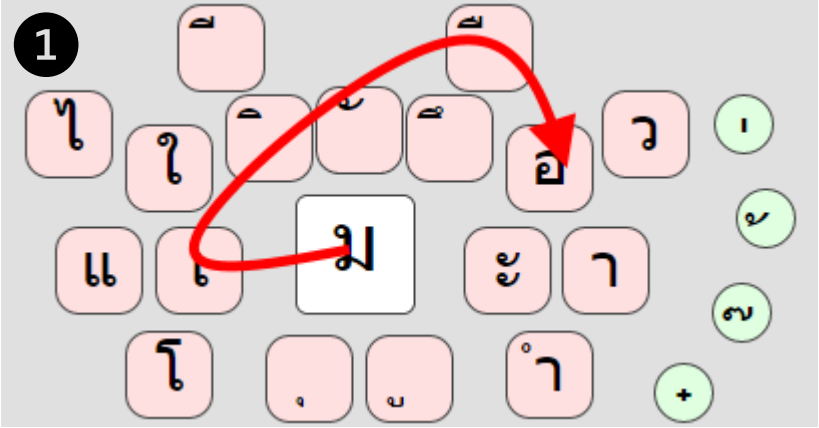
- Syllable order more natural
  - Consonant first, then vowel, tone in single gesture
  - Final consonant a second gesture
- User does not have to think about backing store order but rather the word
- Efficient
  - 1 gesture for open syllables
  - 2 gestures for closed syllables

Thai Satellite – Challenges

- Difficulty showing vowel popup around keys on edges of screen
  - Only an issue on phone-size devices
- Support consonant clusters with surrounding vowels
- A few vowels not yet included, e.g. ฤๅ
- Presentation and style

Thai Satellite – More Possibilities

- Smooth Gestures, e.g. เมือง = curl gesture + tap
  - Gesture should not need pauses
  - Requires heuristic elimination of invalid combinations



Amharic Fidelity

- Amharic is an abugida
  - Each *fidel* represents a consonant + vowel sound
  - 34 consonants, 7-12 forms = 276 fidel
  - V, VC, VCC, CV, CVC, CVCC syllable forms
    - V – vowel; C – consonant
- Example: [d] consonant + vowels

d	ደ	ዱ	ዲ	ዳ	ዴ	ድ	ዶ	ዷ
[d]	de	du	di	da	de	d(ə)	do	dʷa

Amharic Fidelity – Characters

ሀ	ሁ	ሂ	ሃ	ሄ	ህ	ሆ	ኸ	ኹ	ኺ	ኻ	ኼ	ኽ	ኾ
ለ	ሉ	ሊ	ላ	ሌ	ል	ሎ	ወ	ዉ	ዊ	ዋ	ዌ	ው	ዎ
ሐ	ሑ	ሒ	ሓ	ሔ	ሕ	ሖ	ዐ	ዑ	ዒ	ዓ	ዔ	ዕ	ዖ
መ	ሙ	ሚ	ማ	ሜ	ም	ሞ	ዘ	ዙ	ዚ	ዛ	ዜ	ዝ	ዞ
ሠ	ሡ	ሢ	ሣ	ሤ	ሥ	ሦ	ዠ	ዡ	ዢ	ዣ	ዤ	ዥ	ዦ
ረ	ሩ	ሪ	ራ	ሬ	ር	ሮ	የ	ዩ	ዪ	ያ	ዬ	ይ	ዮ
ሰ	ሱ	ሲ	ሳ	ሴ	ስ	ሶ	ደ	ዱ	ዲ	ዳ	ዴ	ድ	ዶ
ሸ	ሹ	ሺ	ሻ	ሼ	ሽ	ሾ	ጀ	ጁ	ጂ	ጃ	ጄ	ጅ	ጆ
ቀ	ቁ	ቂ	ቃ	ቄ	ቅ	ቆ	ገ	ጉ	ጊ	ጋ	ጌ	ግ	ጎ
በ	ቡ	ቢ	ባ	ቤ	ብ	ቦ	ጠ	ጡ	ጢ	ጣ	ጤ	ጥ	ጦ
ተ	ቱ	ቲ	ታ	ቴ	ት	ቶ	ጨ	ጩ	ጪ	ጫ	ጬ	ጭ	ጮ
ቸ	ቹ	ቺ	ቻ	ቼ	ች	ቾ	ጸ	ጹ	ጺ	ጻ	ጼ	ጽ	ጾ
ኀ	ኁ	ኂ	ኃ	ኄ	ኅ	ኆ	ፀ	ፁ	ፂ	ፃ	ፄ	ፅ	ፆ
ነ	ኑ	ኒ	ና	ኔ	ን	ኖ	ፀ	ፁ	ፂ	ፃ	ፄ	ፅ	ፆ
ኘ	ኙ	ኚ	ኛ	ኜ	ኝ	ኞ	ፈ	ፉ	ፊ	ፋ	ፌ	ፍ	ፎ
አ	ኡ	ኢ	ኣ	ኤ	እ	ኦ	ፐ	ፑ	ፒ	ፓ	ፔ	ፕ	ፖ
ከ	ኩ	ኪ	ካ	ኬ	ክ	ኮ	ቨ	ቩ	ቪ	ቫ	ቬ	ቭ	ቮ
ቈ	ቋ	ቌ	ቈ	ኈ	ኋ	ኌ	ኈ	ኩ	ኳ	ኬ	ኮ	ዅ	
ዓ	ዔ	ዕ	ዏ	ዐ	ዘ	ዠ	ሟ	ቷ	ጧ	ቋ	ሯ	ቿ	
ጇ	ጃ	ኗ	ኟ	ዷ	ፏ	ፗ	ፚ	ሯ	ሻ	ሬ	ኧ		

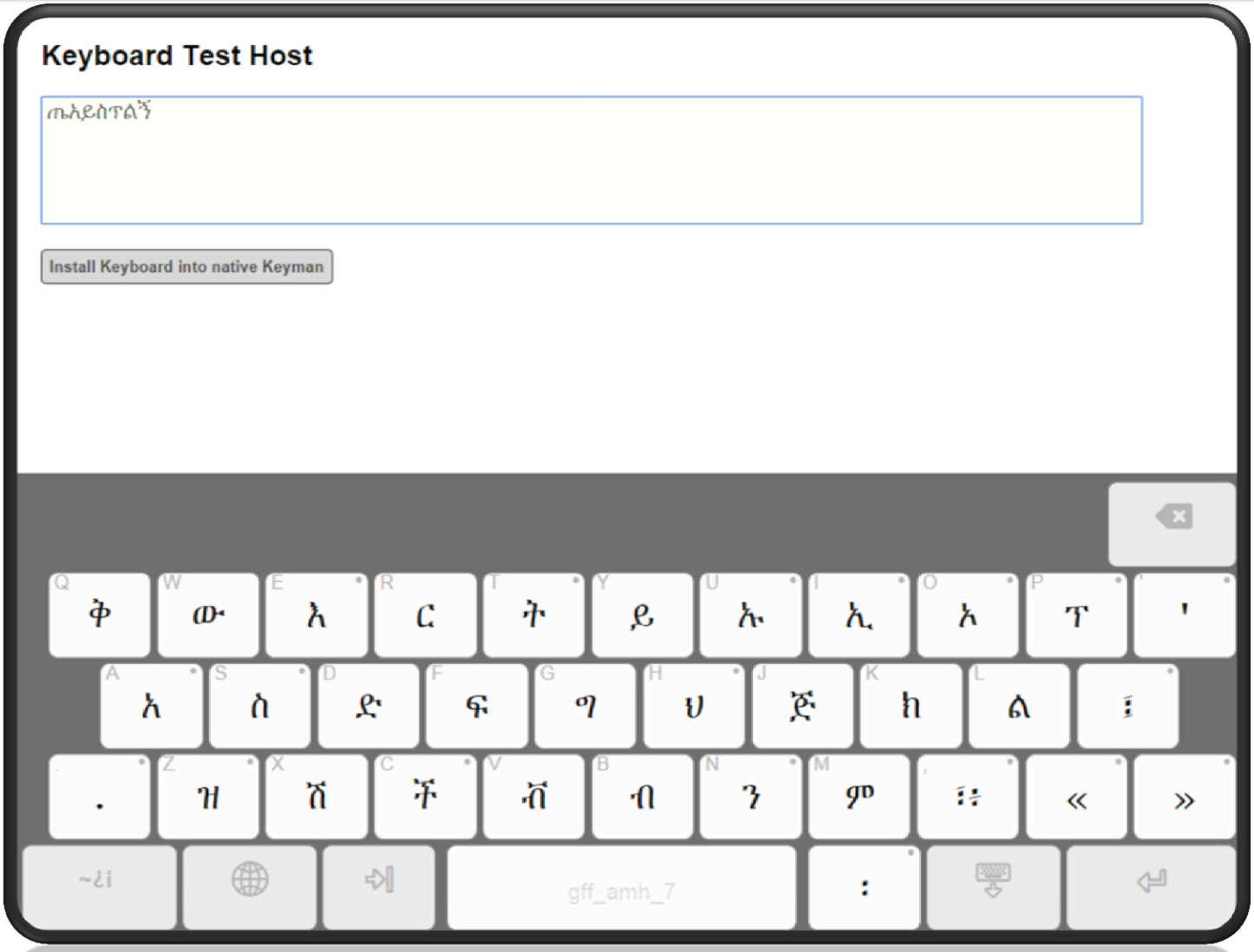
Amharic Fidelity – Touch Design

- Could use gestures, but tried something different
- Multi-tap instead of slide gestures
- Uses 5 rows
  - Row 1: blank space
  - Rows 2-4: initial consonants.
  - Row 5: space + controls.

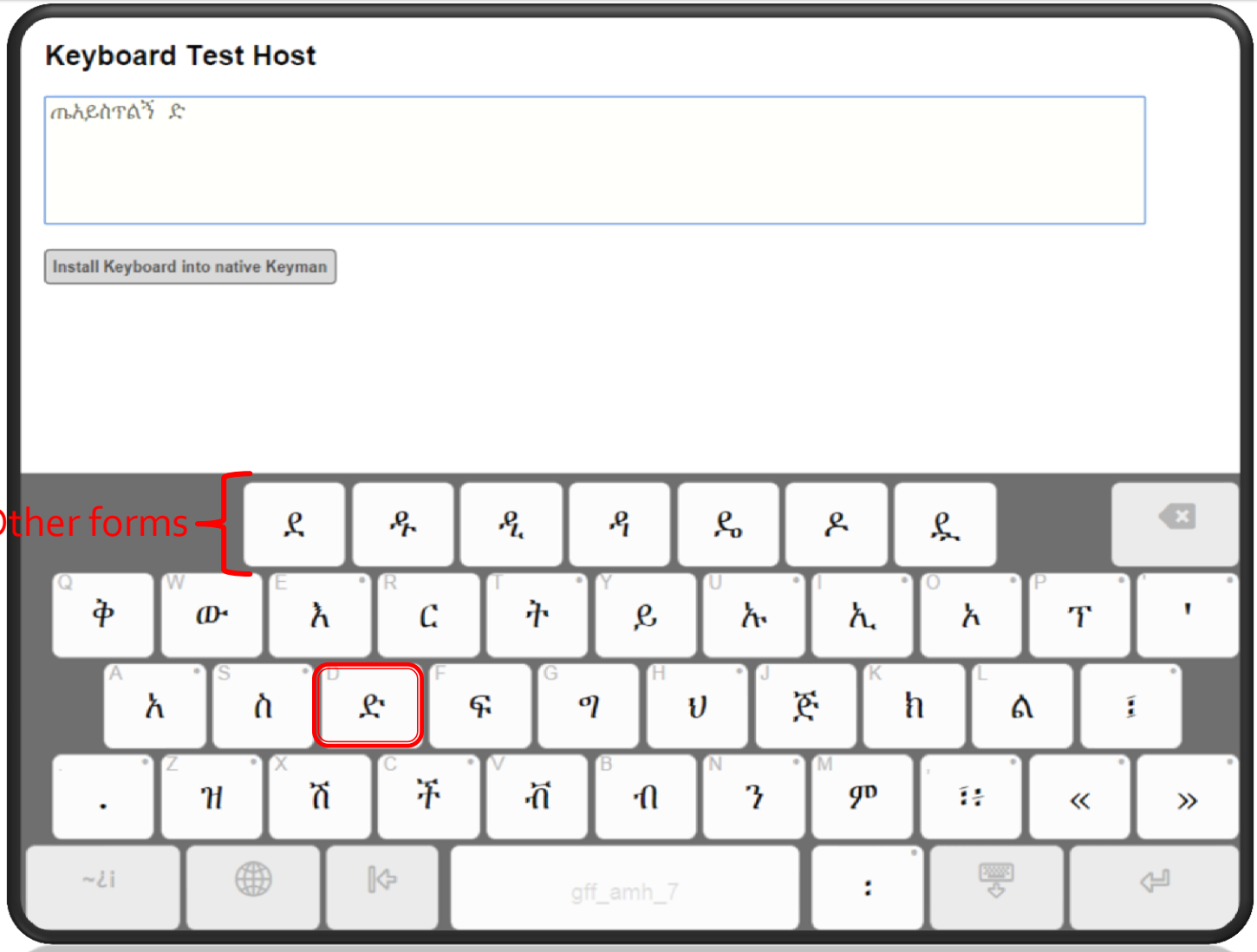
Amharic Fidelity – Touch Design

- Isolate or final form fidel keys on base layer
- Each isolate fidel key triggers display of alternate forms across top row.
- Only 26 of 34 base fidel shown.
  - Related consonants are under slide menu.

Amharic Fidelity – Base Layer



Amharic Fidelity – [d] layer



Amharic Fidelity – Advantages

- Discoverable
  - Users often find it hard to locate some forms on desktop; this should not happen here
- Intuitive
  - Syllable combinations natural to enter
  - Never forced to switch layers manually
- Consistent
  - Exploits language structure for efficient input

Amharic Fidelity – Further Work

- Base layer could be better organised?
  - Still based roughly on QWERTY
- Gestures may be even more efficient for selecting other forms

DISCUSsion

- Communicate
  - Marc Durdin
  - Twitter @MarcDurdin or @keyman
  - Web http://keyman.com
  - Email marc@keyman.com