Keyboard as Co-Author:

Biometric Evaluation of the Touch Screen Typing Quality

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Text Input Evolution

- Historically, keyboard is one of the most conservative peripheral devices
  - Minor changes in shape, a periodic increase in the number of key – that's all changes in the recent years
- The projects directed to the creation of a new keyboard do not lead to mass product output
  - Devices require long training and/or their price is too high
  - Achieved improvements are insignificant and cannot justify the projects

Almost successful attempts to create a keyboard anew

The On-Screen Keyboard has Changed This Trend

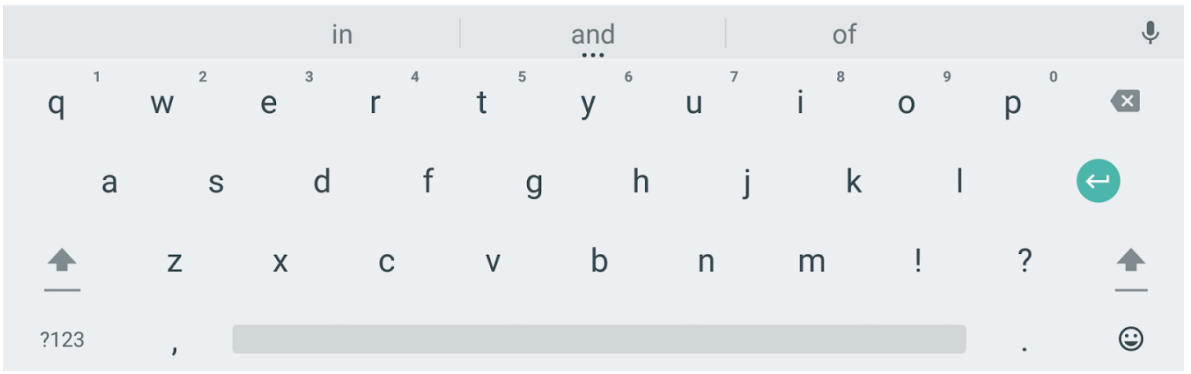
- The quality of the input on a capacitive touch screen is not satisfactory while copying a desktop keyboard
  - There is no tactile feedback, and the dimensions are non-standard
- The possibility of hardware improvements is small
- The keyboard of popular mobile platforms is getting a co-author who finishes the text to its own taste
  - Is it rather good or rather bad for the platform?

Keyboards to be Tested

Hardware keyboard by Asus

Onboard from Ubuntu 16.04

Default AOSP Keyboard from Android-x86



Complexity of the Text (Q1>Q2>Q3)

- Q1. Text in an unknown language
  - Pseudo-Latin – so-called «Lorem Ipsum»
    - Scrambled phrases of the treatise «O De finibus bonorum et malorum» by Cicero, commonly used in typesetting for demo purposes :)
- Q2. Difficult text in the native language
  - The descriptions of nature in Russian literature
    - «War and Peace» by Leo Tolstoy, «Lady Macbeth of Mtsensk» by N.S. Leskov, and «Aptekar» by Vladimir Orlov
- Q3. Typical texts of instant messaging
  - Free verses by Charles Bukowski, taken from «The Last Night of the Earth Poems»

Q=Q1 (Unknown Language)

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Q=Q2 (Difficult Native language)

Не взглядом естествоиспытателя смотрел я на клен. Вовсе не был намерен исследовать, предположим, какие у головинского клена листья – цельные, супротивные либо перисто-сложные. Не делился он для меня на составные – корень, штамб, ствол, крона, ветви, листья. Далекие фигуры – все без ртов, далекие деревья – без ветвей. Далекие вершины – без камней: они, как брови, тонки, неясны. Далекие теченья – без волны: они – в высотах, с тучами равны. Такое в этом откровенье!

Лунный свет, пробиваясь сквозь листья и цветы яблони, самыми причудливыми, светлыми пятнышками разбегался по лицу и всей фигуре лежавшей навзничь Катерины Львовны; в воздухе стояло тихо; только легонький теплый ветерочек чуть пошевеливал сонные листья и разносил тонкий аромат цветущих трав и деревьев. Дышалось чем-то томящим, располагающим к лени, к неге и к темным желаниям.

нужно
много
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не
всякий
может
или
написать
или даже
прочесть
их.

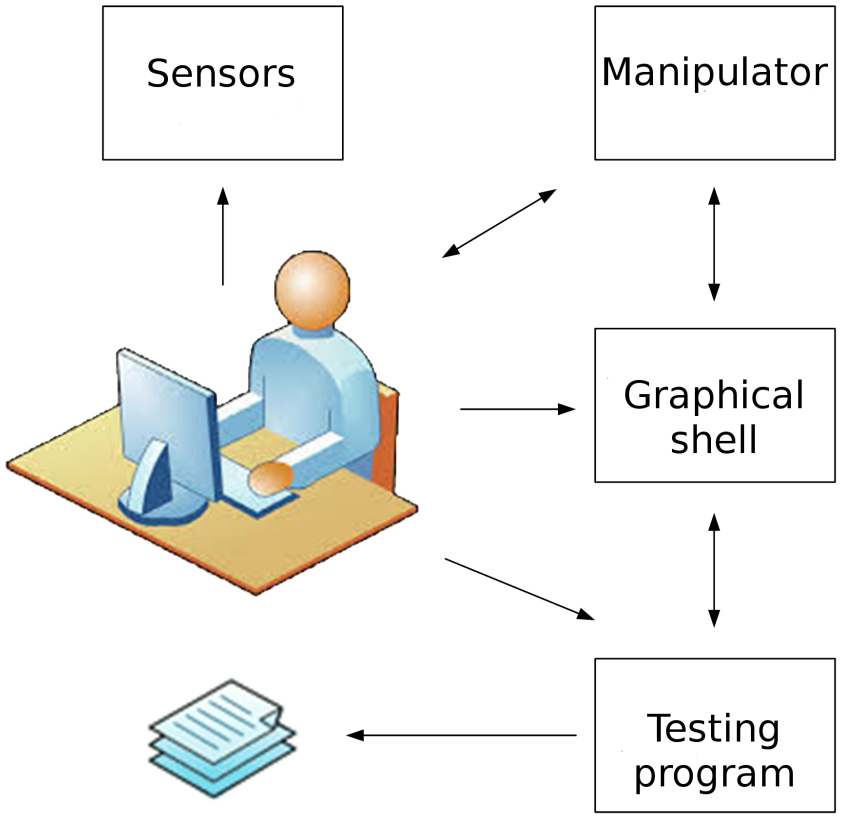
Q=Q3 (Chat Model)

отмечали Новый Год, кажется, у
меня.
я стоял держа стакан когда
этот стройный молодой тип подошел
он был чуточку пьян - и сказал
"Хэнк, я познакомился с одной бабой,
которая утверждает,
что была замужем за тобой 2
года."
"правда?
как ее
звали?"
"Лола
Эдвардс."
"никогда о ней
не слыхал."

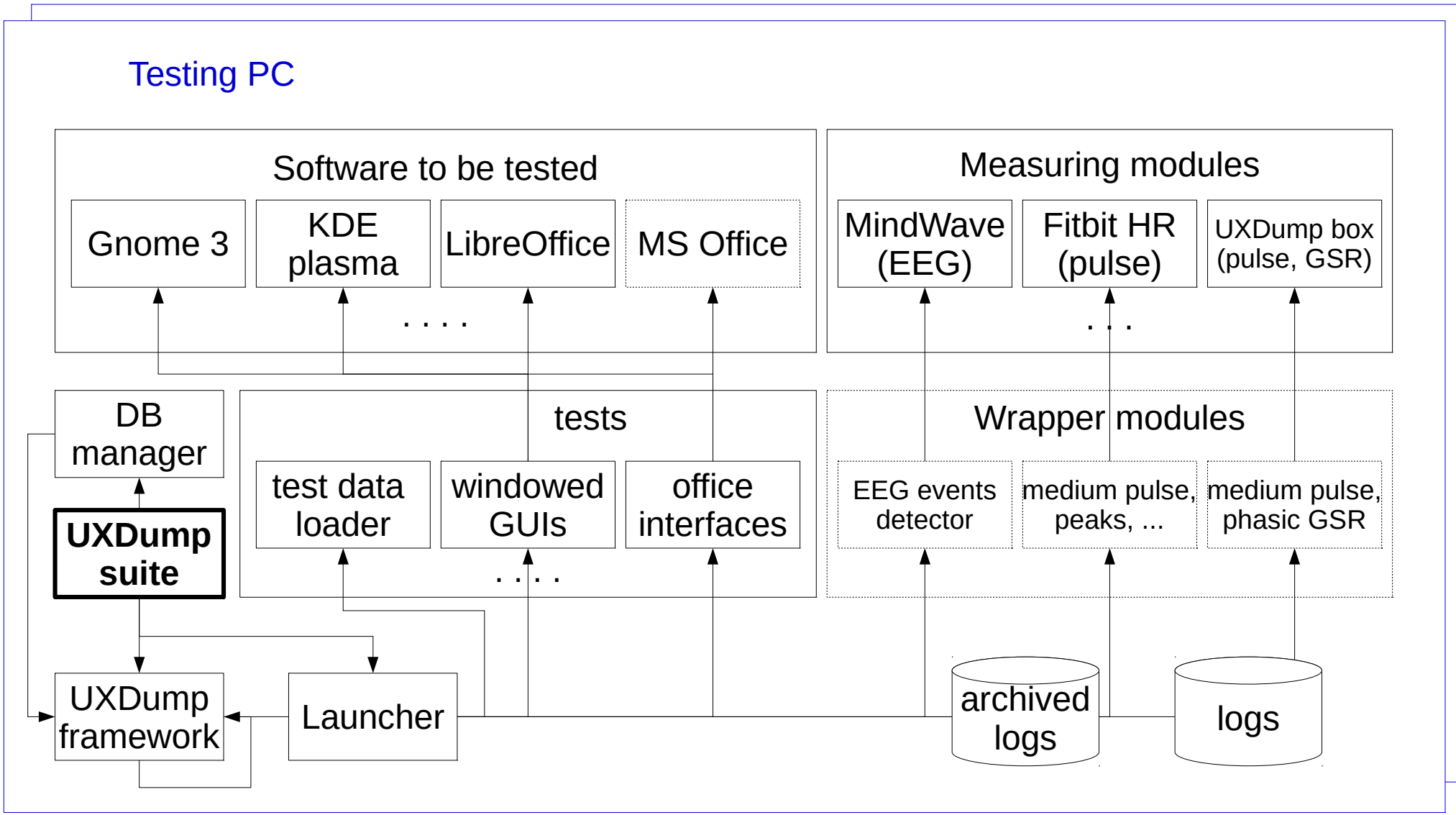
Scheme of Testing

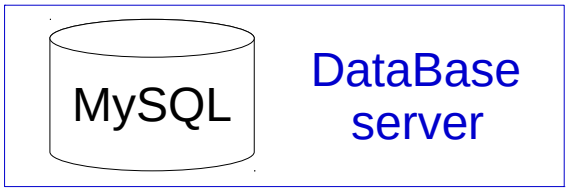
- A User is typing the text
- Time and errors made are taken into account
- Heart rate measurements are taken
- Attention level is estimated by a consumer-grade encephalograph

The data are gathered during our project, the UXDump suite

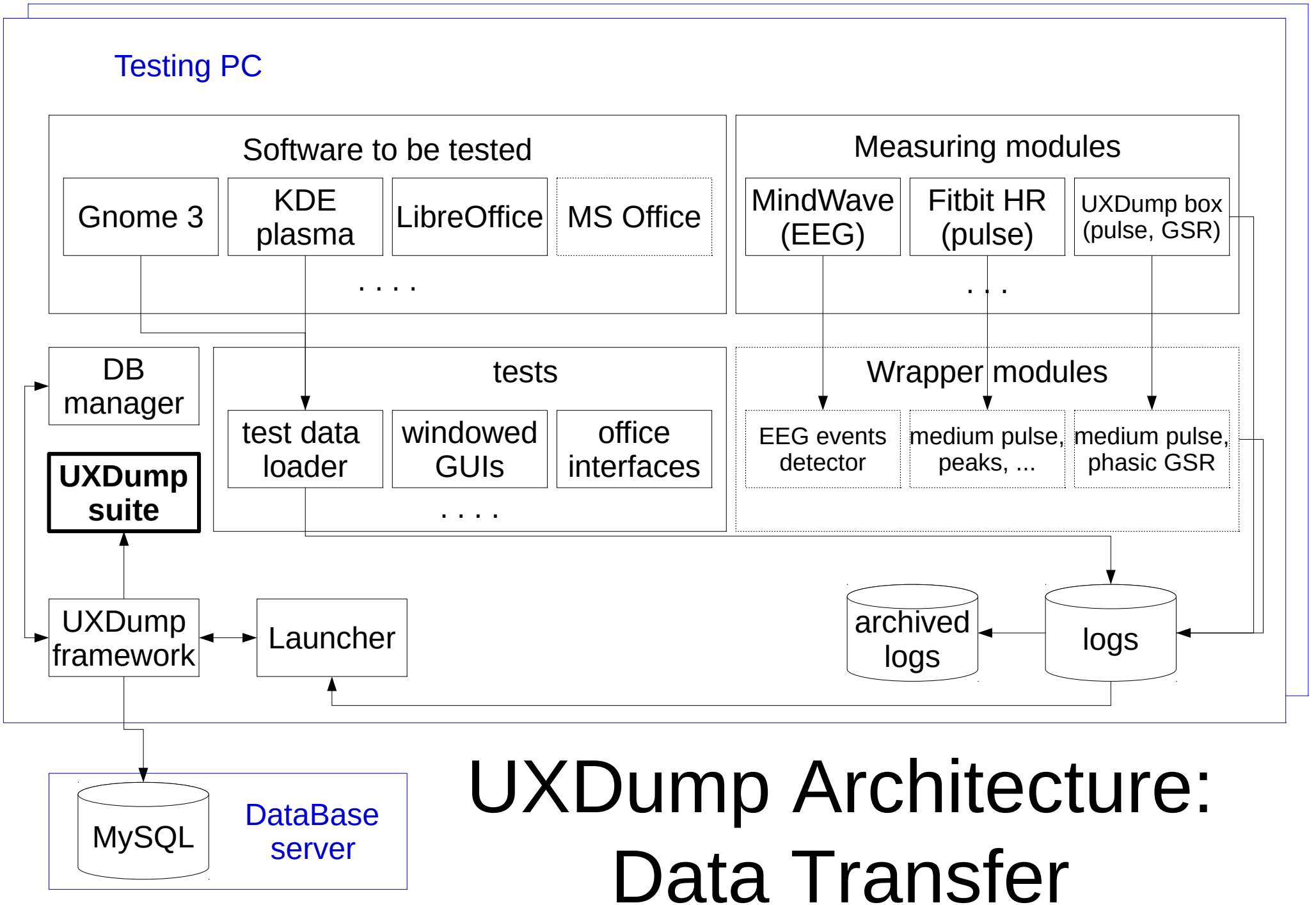


https://bitbucket.org/AsyaAliset/uxdump





UXDump Architecture: Flow Control

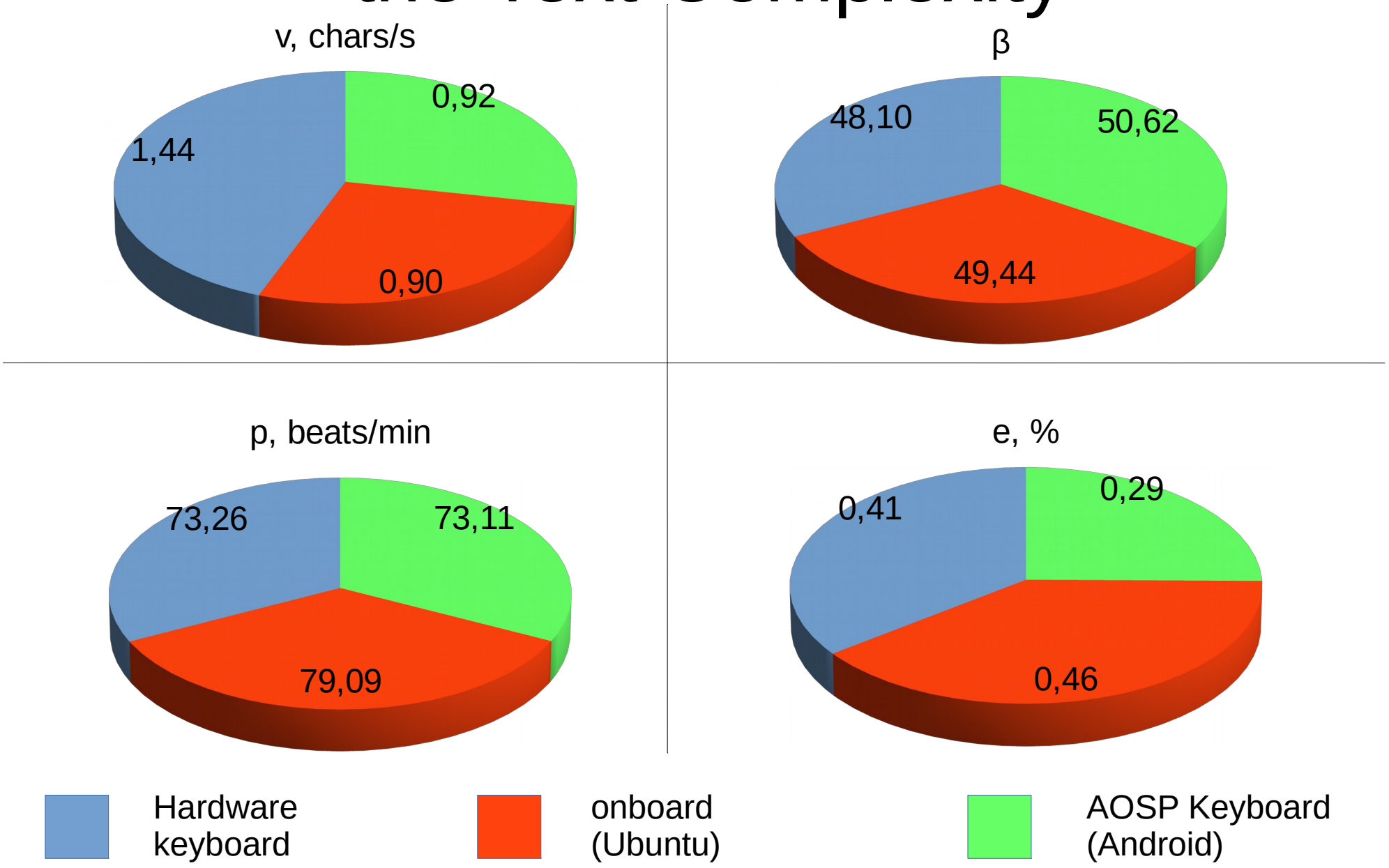


UXDump Architecture: Data Transfer

Factors

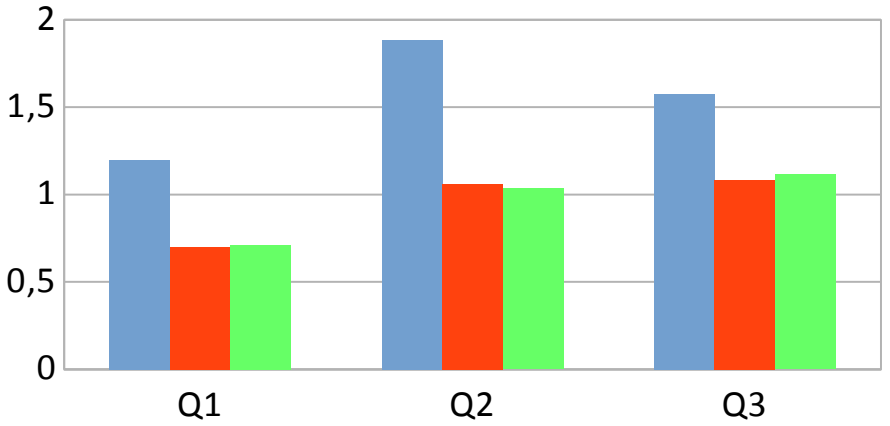
- Primary Factors for Evaluation:
  - The duration of the operator's activity to perform specified actions, τ
    - typing rate υ – a number of correctly typed symbols the operator generates per second
  - A number of mistakes made during the test, e
    - uncorrected errors are taken into account
  - Pulse, p
    - Average heart rate during the test
  - The operator's attention level, β
    - The «attention» metrics of the NeuroSky consumer-grade EEG headsets are used

Without Taking into Account the Text Complexity

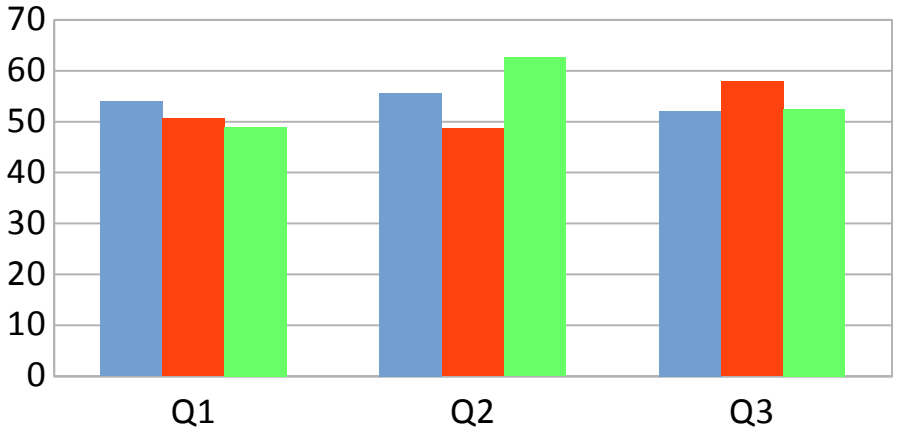


Taking into Account the Text Complexity

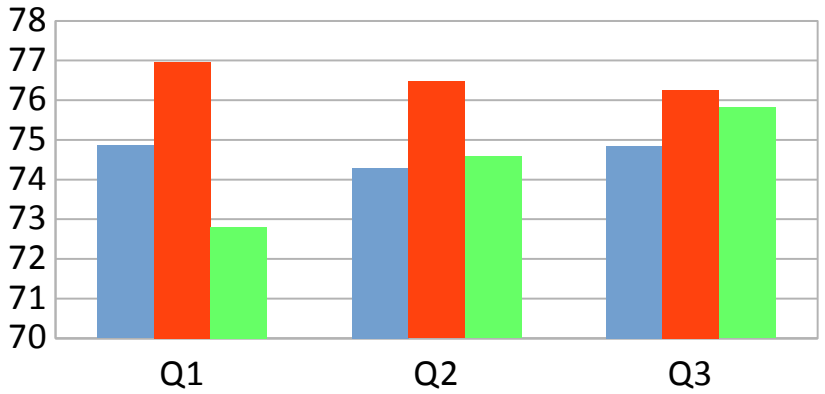
typing rate, υ, chars/s



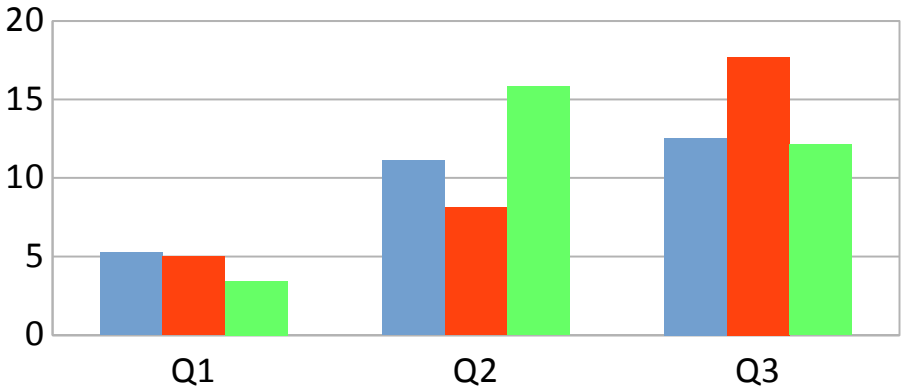
medium attention level during the test, β, a.u.



medium heart rate during the test, p, beats/min



Number of errors, e



Typing Rate

- Hardware Keyboard
  - A maximal rate for all texts
- Ubuntu Keyboard
  - A minimal rate for Q1 and Q3 texts
- Android Keyboard
  - A minimal rate for Q2 text
    - Obviously, the keyboard cannot cope with the vocabulary of Russian writers :)
- The rate is directly proportional to the complexity of the text for all keyboards

Pulse
(User's Physical State Indicator)

- Hardware Keyboard
  - A minimal pulse for Q2
    - A lulling rhythm of the descriptions of nature
- Ubuntu Keyboard
  - The pulse is directly proportional to the text complexity
- Android Keyboard
  - The pulse is inversely proportional to the text complexity
    - It is explained by the specifics of man handling of auto-correction

Attention Level

- Text in an Unknown Language (Q1)
  - maximum with a hardware keyboard
  - minimum with an Android keyboard
    - The Latin basis of European languages influences the auto-correct effectiveness
- Difficult Text in the Native Language (Q2)
  - maximum with a hardware and Android keyboards

Error Number

- Hardware Keyboard
  - inversely proportional to the text complexity
- Ubuntu Keyboard
  - inversely proportional to the text complexity
- Android Keyboard
  - Error Peak at Q2
    - Auto-correction fails again

Conclusions on Typing Rate

- The On-Screen Keyboard as an Active Agent
  - ...increases the speed and quality of typingof low and medium complexity texts (Q2 and Q3),
  - …becomes a substantial source of stress, errors, efficiency decrease in case of dealing with a difficult text (Q1),
- In most cases, Classic On-Screen Keyboard lags far behind in efficiency...
  - …being a strong negative factor for the platforms based on it;
- No doubt, the intuition and automaticity levels while working with a hardware keyboard are still unattainable to on-screen keyboards

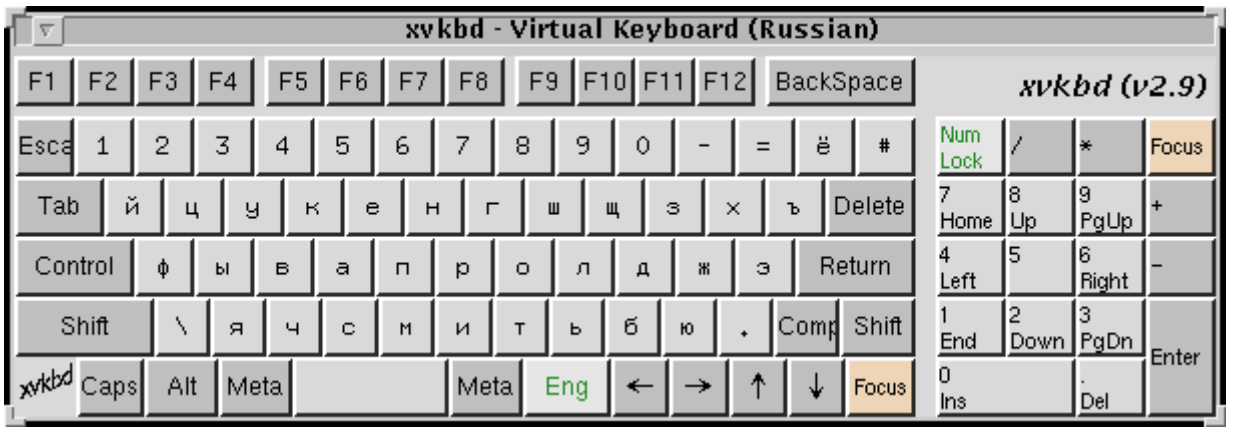
If we Want to Use

Classic DE in Touch Screen Devices, we Need

Auto-Completion and Auto-Correction!

What we Have (1/4)

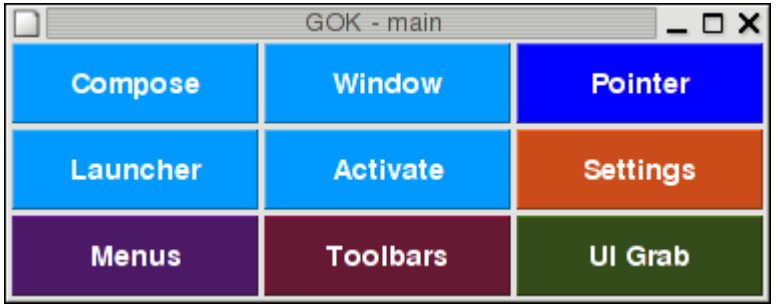
Florence

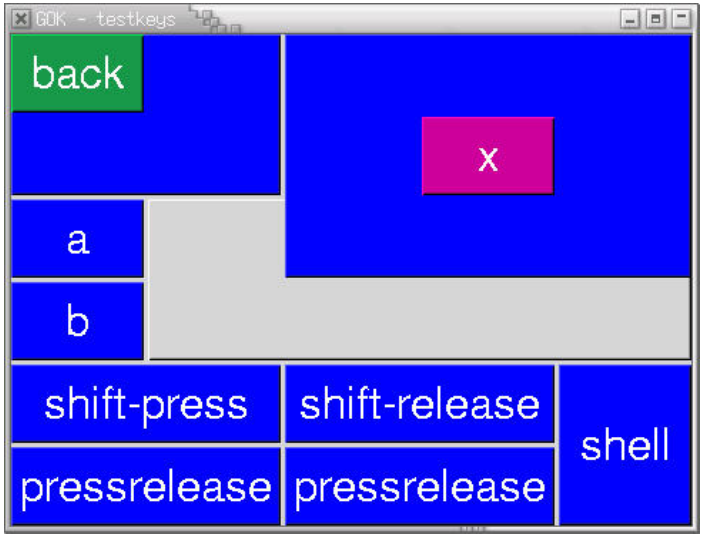


XVKBD

What we Have (2/4)

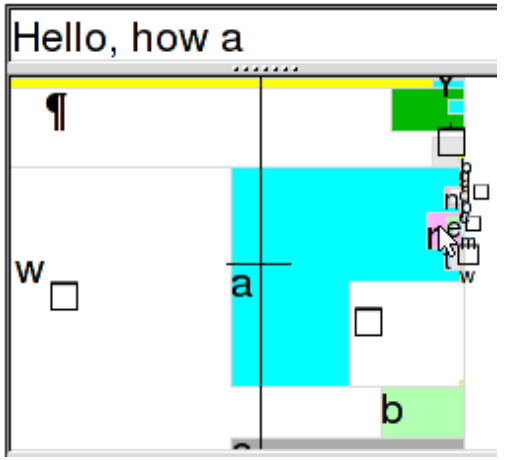
- GOK: yes, but… no :)

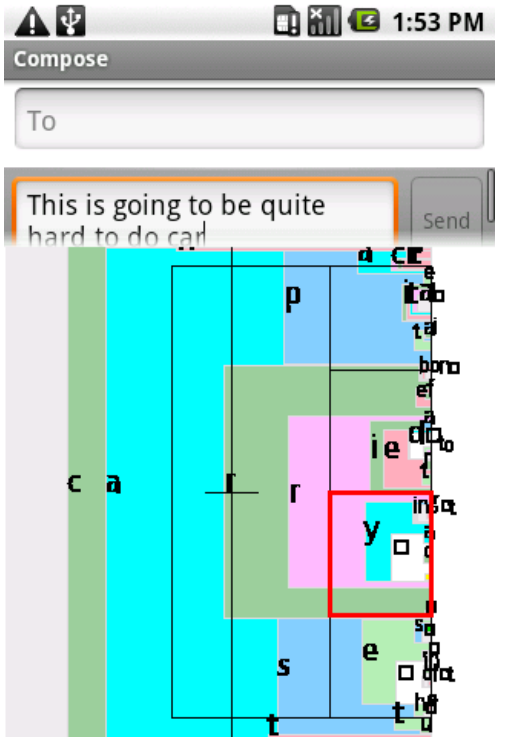




What we Have (3/4)

- We have Dasher
  - It is unusual and fast
  - It has even an Android version
  - What do users think?
    - Users really want the keyboard to look like a keyboard :)

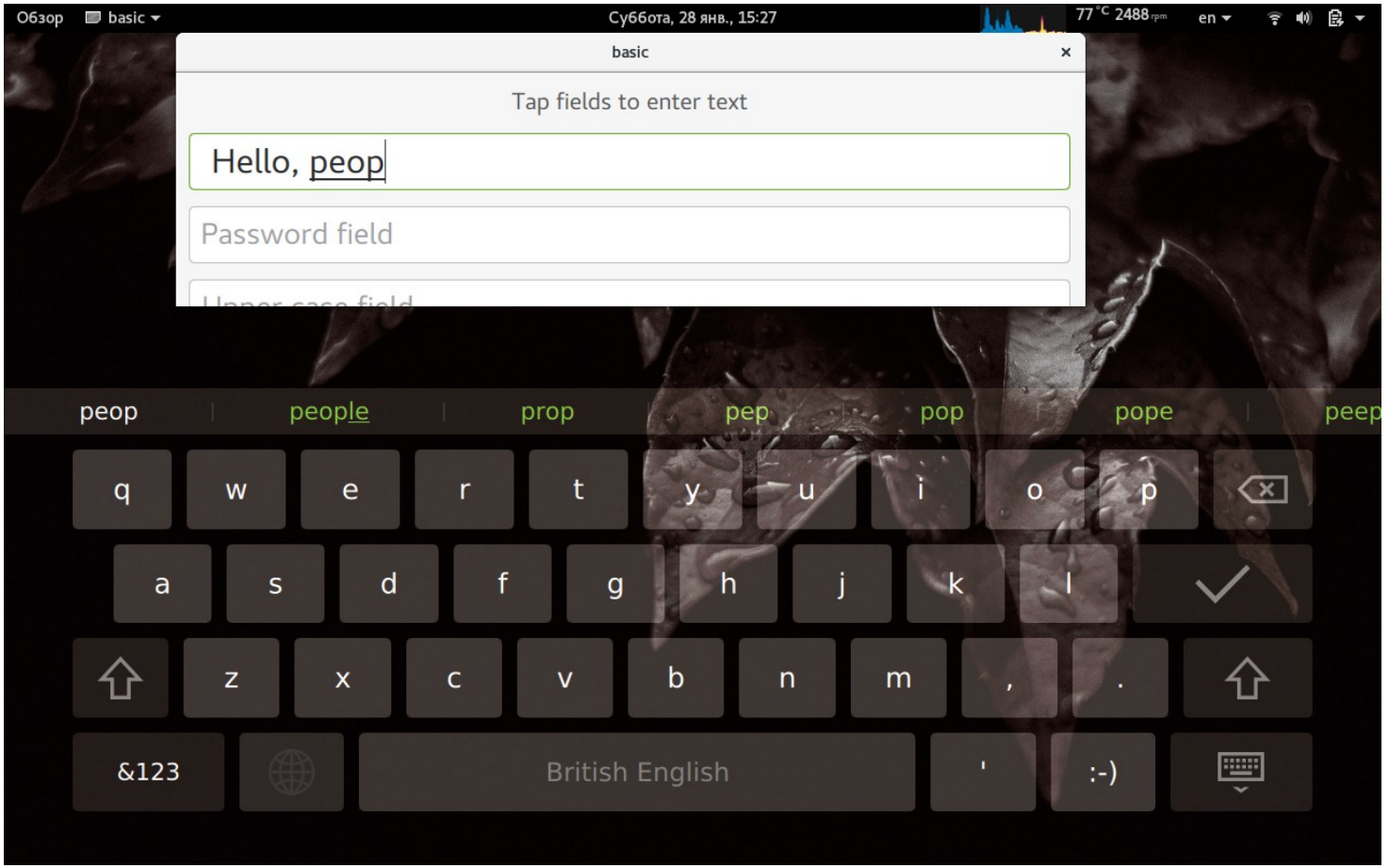




	Android version downloads
Dasher	10-50 thousands
Hacker“s keyboard	1-5 millions
Google keyboard (gboard)	500 millions - 1 billion

What we Have (4/4)

- Qt Virtual Keyboard (C++/QML)
  - Created for Qt Embedded, but still usable on a desktop in case Qt *knows* about it:



GNU/Linux Systems do Really Needs Heuristics-Driven Universal Keyboard Looking like Qt Virtual Keyboard, AOSP Keyboard etc.