Technology for the most compact alphanumeric keypad

In this paper you will find answers for the following questions

What is UniTap?

Miniature. Up to 16 times smaller than regular keyboard. Ideal solution for mobile mini keyboards.

Ergonomic. Ergonomics of conventional computer keyboard. Uniform design, fast input.

Intuitive. No difference from operating with regular computer keyboard. No special learning is required.

Functional. Full computer keyboard functionality. Flexible design. Easy integration into different devices.

Low cost. Using existing keys and switches technologies. The cost is comparable to the cost of regular keypads.

What is it for?

Mobile Internet and messaging are considered to be the engine of the next generation of mobile devices. New smart telephones from leading manufacturers will provide full pocket computer functionality. They will allow users to browse the Internet, send and receive email and SMS, and handle personal data and information. Thus, they will provide all services to mobile users. However, one of the most important issues that could slow down or even prevent such devices from being widely used is the awkward user interface for text input.

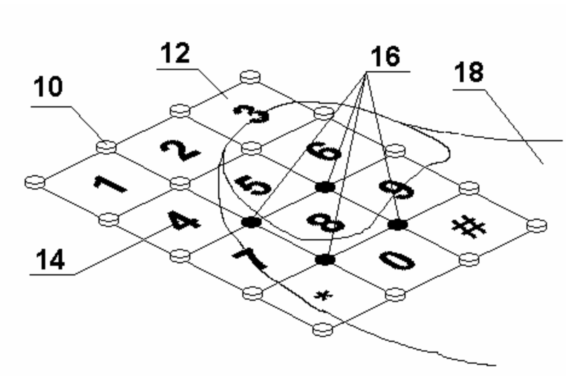
As soon as SMS became popular, traditional 12-button multi-tapping for alphanumeric input was considered to be a major drawback. Many companies explored different approaches to solve this problem. Some of the solutions are based on predictive input using existing 12-button alphabet legend (Tegic Communications, Motorola, Zi); some others are based on voice recognition. These solutions are helpful, but still limited in practical use.

Using a common keyboard has always been considered to be the most efficient way of alphanumeric input. Therefore, some manufacturers of mobile devices have embedded compact keyboards into their devices (Blackberry, Handspring). Other manufacturers designed electronic keyboard add-ons (Ericsson, Alcatel). Such keyboards provide a simple and familiar interface, but they are small. Because of the size the keys on these keyboards are difficult to press without pressing adjacent keys. Advanced passive chorded keyboards (DigitWireless, Intel) increase usability of a compact keyboard, but they are far form being ideal, because they have a non-uniform, unfamiliar layered interface and they still do not have an optimal size.

Thus, a technology that would preserve ergonomics of a full-size conventional computer keyboard, but allow for its use in small mobile devices, is still demanded. UniTap is the right technology to satisfy this demand, since it allows a full Latin alphabet keyboard in about one square inch only. Numbers, letters, symbols and other functions are available by a single finger stroke.

How it works?

Our patent pending technology UniTap combines advantages of miniature and passive chording keyboards. The main idea is based on interpreting activation of several switches as a meaningful function; however, unlike common practice of other solutions, this does not prevent from having uniform legend symbols placements. Such approach allows for preserving ergonomics of full-size key caps, while increasing functional elements density from 8 to 16 times comparing to the regular computer keyboards.



To give the clear picture of the principles of our invention, let us consider example of its utilization in a small telephone-style keypad (although the technology itself is not restricted to any specific layout). In this case, the numbers are just printed on the keypad surface **14**, and each number is surrounded by 4 miniature pin keys **10** as shown in figure. These keys are placed in the corners of each rectangle **12**, which represents unique symbol, and, thus, 4 adjacent rectangles share the same key in their common corner. The dimensions of such rectangular areas are about one third of the width of the adult finger or standard computer key cap.

Suppose now that you would like to type number “8”. In order to do so you simply touch the respective symbol printed on the surface. When your finger **18** touches this symbol, it at the same time hits corner keys **16** (although you even might not notice it in some implementations). The device monitors the status of these keys and accepts numbers (or symbols) when their respective combinations are triggered. In our case an appropriate combinations would be a set of 4 keys being at corners of the same rectangle and also its subsets that can uniquely identify the symbol (for example, 2 keys spanning diagonal of a symbol area).

The trick is that such sharing of the pin keys between symbols allows for making size of the area required by each symbol much smaller compared to the regular keyboard. For example, the numeric keypad in the figure is about 9 times smaller then regular-sized numeric keypad (some implementations allows for 16 times size reduce), while it is used with nearly equivalent comfort. Additionally, legend symbols are placed uniformly and in natural way, which does not require learning from users.

How it compares to others?

○-Best ◎-Moderate ●-Bad	Voice Recognition	Predictive Algorithms	Prefix-based Algorithms	Multitapping	Stoke Recognition	Handwriting	On-screen Keyboard	Integrated Keyboard	Accessory Keyboard	Fastap™	**UniTap**
Hands-free	○	◎	◎●	◎	●	●	●	●	●	◎	◎
Portability	○	○	○	○	◎	◎	◎	●	●	◎	○
Cost	●	◎	○	○	◎	●	◎	●	◎	◎	○
Speed	◎	◎	◎	●	◎	◎	◎	○	○	○	○
Accessibility	●	●	●	●	●	●	●	○	○	○	○
Training	◎	◎	◎	◎	●	◎	○	○	○	○	○
Flexibility	●	●	◎	◎	●	○	○	○	○	○	○
Simplicity	●	●	◎	◎	◎	○	○	○	○	○	○
Language	●	●	◎	○	○	○	○	○	○	○	○
Privacy	●	○	○	○	○	○	○	○	○	○	○
Density	N/A	2-4	2-4	2-4	N/A	N/A	N/A	2-4	3-4	6-8	8-16

This comparison chart is an expression of expert's view and may contain subjunctive classification of existing approaches.

Characteristics presented in the table above are the following:

- **Hands-free** – number of hands (1 or 2) required for proper operation
- **Portability** – size of input surface, ability to be used in various devices
- **Cost** – cost of production (cost of operation)
- **Speed** – average speed of character input
- **Accessibility** - disability use
- **Training** – amount of training and adaptation required

- **Flexibility** – possible usage restrictions
- **Simplicity** – easiness in understanding and usage
- **Language** – language independence
- **Privacy** – level of privacy violation
- **Density** – number of available functions per finger area unit

Existing technologies and solutions for alphanumeric (word) input into compact devices include:

Voice recognition. It is software technology that processes voice input and tries to recognize known words said by the speaker. Its implementation has comparatively high processing power and memory requirements. User/software adaptation and learning is requested. It also implies out loud speaking, which might violate user's privacy.

Stroke recognition. This technology uses sensor elements (usually touch-sensitive screens of reasonably high resolution) which track path made by pen or stylus while writing one character. User thus writes one character in a time normally in quite friendly form, which, however, should be preliminary trained for better performance. Examples include UniStroke, Graffiti, etc.

Handwriting recognition. This technique is designed to process the complete path of a pen while writing the whole word in a regular handwriting manner. Although such solution would be extremely useful and convenient, reconstruction of the word from a stroke is a very difficult task not yet completely and efficiently solved.

On-screen keyboards. Devices having touch-sensitive screens, such as PDAs, may have an option of placing keyboard in a special area on a screen when alphanumeric input is required, e.g. email editing. This solution works well, but it consumes significant area of screen making the working area less readable. Besides, it can not be used on devices which do not have touch-sensitive panels.

12-button multitapping. This approach is currently the most widely-used one. According to this method, each button is assigned several characters which are selected cyclically depending how many times this button is pressed. Thus, typing a character requires about 2 finger strokes in average.

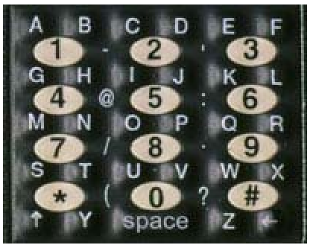
12-button predictive algorithms. This approach is also based on 12 buttons and character assignment similar to multitapping; however, it has dictionary of words stored in memory. Thus, user press sequence of buttons (one finger stroke per button) and the software suggests possible combinations of characters (words) from the dictionary. Examples of this approach include T9™, iTap™, eZiTap™, etc.

12-button prefix-based algorithms. This approach is based on the prediction of a letter using already entered letters and language statistical database. This database is smaller then dictionaries of word-predictive algorithms. It's a good combination of multitapping simplicity and speed of predictive methods. Examples of this approach include LetterWise™ and WordWise™. WordWise™ requires 2 hands for input.

Integrated QWERTY keyboards. This technology stands for regular keyboard having one button per each character integrated into mobile device. Significant reduction in button size makes such keyboards practically inconvenient as several buttons tend to be pressed by a single finger stroke. Examples of such solution include Treo™, Psion, Nokia 9xxx Communicators, etc.

Accessory QWERTY keyboards. These are miniature keyboards which are provided as accessory to the devices having other means of character input (usually, 12-button multitapping). Examples include Sony Ericsson Chatboard™, Motorola iBoard™, Cirque Pocket Keyboard, etc.

Fastap™. According to this technique, character buttons are placed in the space between 12 conventional buttons representing digits in the telephone keypad. They also differ in size and elevation which make them distinguishable by the feel. Each character button has its own legend and should be pressed with no adjacent buttons touched in order to produce meaningful result. Details may be found at Digit Wireless.

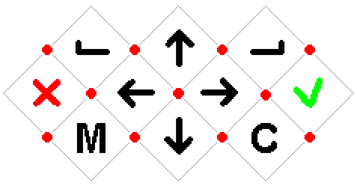


UniTap. The UniTap technology allows for significant increase of functional elements density due to interpreting activation of several buttons as a meaningful character. However, in spite of the small size it provides ergonomic properties comparable to the regular-size keyboard and allows for uniform legend placement where all functional elements have equal elevation and shape.

Which layouts are possible?

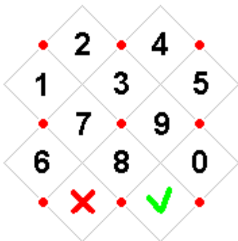
UniTap is basically a technology that allows for making very compact keypads still having comfortable ergonomic characteristics. Being very flexible, it can be utilized in keypads with different layout and geometry, which might be very important for specific applications.

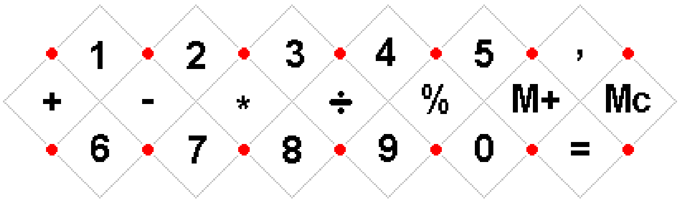
In addition to conventional layouts used for cell phones and QWERTY keyboards (see www.unitap.net/photos.php3), UniTap technology can be utilized in calculators, control pads, etc. Some examples of such layouts are shown below. Red dots on the images represent small pin-keys.



This is a phone control pad. We used rotated 4 pins layout. Some of the functions use 3 pins. This pad has 11 pins for 10 functions. Size is about 22.0x7.5 mm.

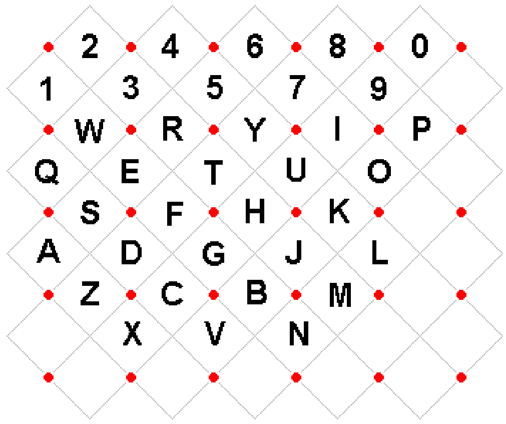
This is basic numeric keypad, using 2 pins per symbol. Its size is just 15x15 mm.

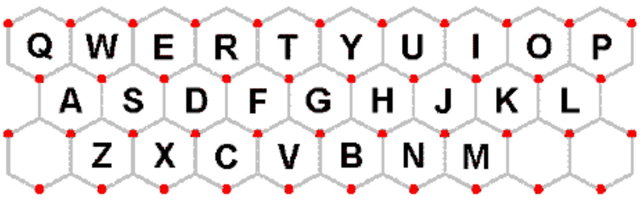




This is a keypad suitable for miniature calculators. Here only 2 pins per function are used. This keypad has 14 pins for 19 functions. Size is about 45.0x7.5 mm.

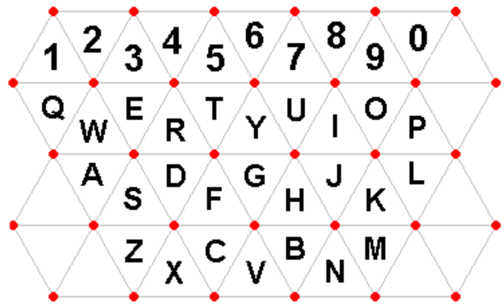
This is full QWERTY alphanumeric keyboard. It has 30 pins for 49 functions. Size is about 37x30 mm.

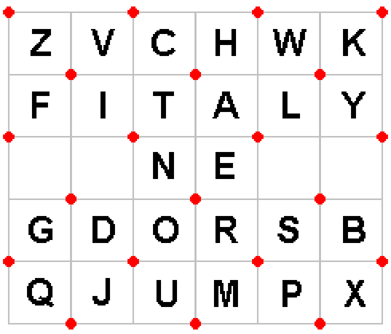




This is another QWERTY keyboard using hexagonal zones and 3 pins per function. Its width is about 5 cm.

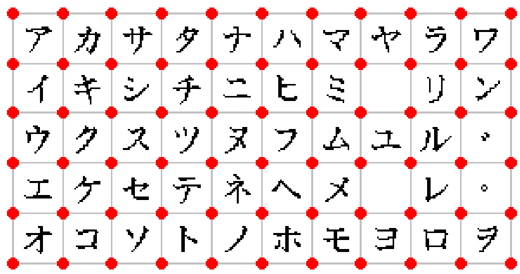
And this is QWERTY keypad using triangular zones and 3 pins per function. Its width is about 4 cm.





This keypad exploits FITALY layout, which is optimized for one finger tapping. Its UniTap implementation has width of about 3 cm. (Fitaly layout is copyrighted and patented by Textware Solutions. Reproduced under permission of Textware Solution.)

This is Japanese Kana keyboard having width about 5 cm.



Where it can be used?

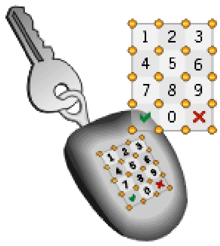
The UniTap technology in its various implementations can provide compact and efficient alphanumeric input in many areas and applications. Among them

Mobile devices

- Smart phones (cellular, wireless, desktop)
- 2-way pagers, peer-to-peer messaging
- Personal Digital Assistants (PDA)
- Tablet, mobile and wearable computers
- Electronic dictionaries and translators
- Digital books
- Calculators
- Compact QWERTY and Kana keyboards

Entertainment

- Smart watches
- Toys and portable gaming equipment
- Music jukeboxes and instruments
- Home electronics, household appliances
- IR and wireless remote control devices



Industry

- Smart card processing devices
- GPS devices
- Access control and security systems
- Bar Code and Labeling Equipment
- Medical Devices
- Electronic Instruments
- Marine, Avionics and Military Equipment

Whom to contact?

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