

finger and middle finger. For the method of Bisset et al. it does not matter which combination of fingers or even objects is used. Therefore, the action that results from a combination of fingers or objects on a sensor pad as taught in Bisset et al. is also categorized as being independent from what actually caused the action. Furthermore, the method by Bisset et al. might work well for a sensing pad on a standard size notebook, it would be difficult to use the method taught by Bisset et al. for small input device, e.g. where the sensor or input device is smaller than the size of two fingers or tips of fingers. Consequently, the functionality would decrease significantly.

**[0011]** An example of the second category of input devices, whereby the action is dependent from what actually caused the activation of the input device, is taught through the use of a large touchscreen in U.S. Pat. No. 6,067,079 to Shieh who teaches a virtual pointing device for touchscreens. Shieh teaches that in response to the user placing his/her hand on a touchscreen, the touchscreen detects the sound pattern of the user's palm site of the hand.

**[0012]** The areas of the touchscreen under user's hand then becomes activated such that certain predefined movements of the user's fingers, thumb and/or palm on those activated areas cause certain functions to be invoked. Shieh further teaches that a single click on, for instance, a fingerprint area invokes a single function, such as the "open" function.

**[0013]** In Shieh, the action is correlated with a part of the hand. However, placement of the hand can be anywhere and in any orientation on the touchscreen as long as touchscreen is able to detect the sound pattern of the palm site of the hand. The placement of the hand on the touchscreen is irrelevant as long as a sound image of the palm site of the hand can be obtained and the relative position e.g. a thumb can be distinguished using the sounds handprint to produce the single action predefined for the thumb. In other words, the absolute position of the thumb with respect to the sensor or input device is irrelevant to the selection process of an action, since the relative position of the thumb to hand is what matters.

**[0014]** Furthermore, Shieh's method relies heavily on a large touch screen to obtain the sound hand image. It would therefore be difficult to apply Shieh's method in an application with a touchscreen that is smaller than the size of a hand whereby it would be impossible to obtain the sound handprint. If Shieh's method would be applied on a smaller touchscreen, the functionality of Shieh's method would decrease significantly, since for example to differentiate between three fingers, all three fingers would have to be contacting the touchscreen at the same time.

**[0015]** Accordingly, with the increasing demand of smaller input devices and enhancement of functionality, there is still a strong need to develop new systems and methods that would be able to maximize the number of actions while minimizing the size of the input device. Additionally, in many cases there is a need for a user to select one out of several actions or functions with his/her hands when it is impossible or unsafe to look at the input device. This situation arises when a user controls a car, a plane, or some other machinery, and therefore (s)he has to look in a specific direction, which may prevent the user from looking at the controls. A similar need arises when the user's

field of view is limited, for example while looking through a viewfinder, or when the input device is not visible at all, e.g. in the dark. In all these situations there is a need to select one out several functions with user's hands based on tactile feedback only, without looking at the controls.

#### SUMMARY OF THE INVENTION

**[0016]** The present invention provides a system and method that increases the functionality of input devices and control panels. The system and method include a dependent relationship between  $n$  functions and  $n$  fingertips. The system and method further include an input sensor, which is associated with the  $n$  functions. A user selects only one of his/her fingertips. The selected fingertip then touches and activates the input sensor. The selected fingertip is the only fingertip that is required to touch and activate the input sensor, thereby allowing the input sensor to be arbitrary small. Up to 8 different functions can be defined for a single input sensor in which each function is correlated and dependent on a fingertip of left or right hand. If multiple input sensors were used in a system, the functionality of that system would then increase significantly. Furthermore, the total number of functions for one input sensor could be further increased to 10 when all the fingertips and thumbs are defined in the dependent relationship between functions and fingertips (and thumbs).

**[0017]** It would even be possible to further increase the number of possible functions for a single input sensor. This could be established by having an input sensor that is not only capable of detecting on/off activation as a result of a fingertip touching or activating the input sensor, but also capable of detecting a motion that is performed by the user at the same time when the user activated the input sensor. In general,  $m_1, \dots, m_n$  motions could be defined respectively corresponding to  $n$  fingertips whereby the total number of selectable functions for that single input sensor increases to

$$\sum_{i=1}^n m_i$$

**[0018]** (whereby  $m_1$  are integers; note that  $n$  fingertips is also corresponding to  $n$  functions).

**[0019]** Once the user selects a fingertip, he/she is aware of the selected function, however, the system or device on which the user wants to select the function is not. In order for the system and method of the present invention to determine and identify which fingertip touches and activates the input sensor an imaging means is included. The imaging means requires the acquisition of at least one image (or images) of a part of the user's hand large enough to identify the selected fingertip that activates the input sensor. After the image is obtained, the image is processed by a processing means to determine which fingertip touched and activated the input sensor. The present invention could further include a feedback means (e.g. through executing the selected function, providing sound, providing a display or the like) to provide the user feedback over the selected function.

**[0020]** In view of that which is stated above, it is the objective of the present invention to provide a system and method to select a function from  $n$  functions on an input