

Possibilities of a multi-functional human-computer interaction in everyday life

Tamás Gregus
and Gábor Geda and Péter Magyar and István Fazekas
Eszterházy Károly College
Institute of Mathematics and Informatics
Eger, Hungary
Email: gregtom6@aries.ektf.hu

Abstract—In the communication between man and machine the usage of a keyboard and a mouse gained ground over the years at a broad scale. At the same time, it can't be said that there isn't a need for new input devices, which would revolutionize this area. There are some ideas which are based on the movement of hands, but those weren't applied to general applications. On this paper let me introduce you to a special glove equipped with sensors, which is able to digitize the movements of fingers, or a hand, besides that, there is a general framework, which can be used to equip the gloves with useful and good properties preferred by the community. Besides that, this paper explains some possibilities of usage.

I. INTRODUCTION

Humans like to discover and explore. We always tried to discover new tools which can simplify our work and everyday life. This innovation was the result of the ingeniousness of men, which can bring a new meaning to everything. Through this improvements bring a new opportunity to give solutions to new problems discovered meanwhile waiting for a solution. Apart from this the absolved and tried solutions should bring an improvement regarding the efficiency on every area, or it should produce results regarding other problems not yet discovered in this area preceding it's time.

The goal of inventions is usually the improvement of public welfare. An invention usually has a reason to exist, if it is inexpensive to reproduce in the first place, and can be developed further, and if there is a need for it in the broad general public. Included in these factors a reversed proportion can be seen, which - with the minimization of logistic and mental work - result in a most useful tool, which can be used on more and more territories and communities. If this succeeds, then there is a bigger chance of a demand in the community.

In the viewpoint of innovation the area of robotics is the one, which has improved the most and had the ability to build a bridge to countless problems, as on the various areas of life successful applications exist. About this branch of information technology it can be said that because of the improvements of more and more factors it can be applied to broader areas. It can be said there are a lot of possibilities to use robotics in teaching[11], [12].

Artificial intelligence can - without doubt - be counted to the most important and at the same time most discussed areas,

without which the development of robots of the future can't be imagined. Considering the results at this time we can't exclude the control of men either. Artificial intelligence is basically based on the simulation of the nerves of the human mind. Forseeably this "fake-knowledge" called intelligence won't be perfect even after decades, mostly because of the huge steps of development. For example the ability of intuition is such a human attribution, which still can't be reproduced in these days with the tools of artificial intelligence. The reason of that is that we couldn't fully explore the electro-mechanical connections and the communication between neurons yet, so we aren't able to reproduce it either, but at the same time there are unclear ethical questions about it as well.

Partly because of this most people prefer another solution, solutions, beside which the control of humans can be sustained. There is a need of solutions which are always at hand, have the ability to be mobilized and easy to understand and are inexpensive at the same time, can be applied at a broad scale and have a reason to exist, so that the tools can assimilate the most to us, without being received as being strange.

If we thoroughly think about it, the most easily manipulateable periphery of our mind are our hands. It contains a lot of mechano- and other receptors, at the same time it is a part of our body, which is able to move in most sophisticated and complicated ways. Because of that, we are able to influence the real world with it, so it is not just a passive tool, but it helps us to live our lives. It can be influencing our destiny, because it is able to give life, and take it away, without question the "most useful" part of our body.

Because of that, it would be a mistake to not use its abilities. And because it's basically a useful and surely an important "tool", our next aim could only be the further development of it. And it is not just a usual goal to extend it's properties in a form of an augmentation of some kind. Essentially the usage of tools can be looked at this way. Countless examples similar to this exist already, which are able to extend the functionality of our organs. A glove, which can be easily programmed by anybody, would be a key for the solution of a lot of problems in our hands.

II. EARLIER IDEAS

We could see countless ideas including special gloves, or just sensors connectable to the fingers. There was an idea, with which a computer mouse could be replaced[1], or could be used to control video games[3]. Probably it isn't surprising that it was tried in the area of war[5]. A successful tool for deaf people was also developed to help them communicate with healthy people[2], [8]. Some kind of gloves were also used for medical purposes[9], [10].

Although it had a lot of applications, there are much more opportunities for further appliance. Those tools were too special, they were used on one area. It could be a goal that it could become a generally usable periphery, like eg. the mouse.

III. NEW POSSIBILITIES OF USAGE

These days more and more things are influenced by money and because of that in a lot of countries families materially get into a worse situation. The lifestyle of richer and poorer families steadily differ from each other more and more. Teenagers often want to try a new instrument, but often realize that it isn't suitable for them. Unfortunately instruments are rather expensive these days. It could be appealing to get to know the instrument through a simulation. In the case of keyboard-instruments the use of a computer and a keyboard isn't a good solution, because the structure of the keyboard differs greatly from those ones. In case of wind and string instruments not even this possibility exists. A special glove could be a solution to the problems mentioned before, because there is no need to model the operation, but only the usage. Accordingly a paper roll could replace a flute or a table the keyboard of a piano[7].

Another possible application of the glove in our rushing world would help those who mostly use public transportation. With the help of the gloves it would be possible for persons who travel a lot to not look at their watches, because that would only show the time, as well as not having to know the time tables of busses and trains by heart. In contrast if various time tables of public transportation would be stored, the user could - with a simple movement of the hand - get information about the time left to reach the destination, so that over time it would be possible to adaptively learn when to get going to reach the destination in time.

Another area of application is the manipulation of subjects in a 3D-environment[6]. There could be a demand for this in games and planning-applications, creating a new kind of controller, a much more "life-like" controller for the persons controlling those games or simulations. Even for medical or other simulations it could become useful. Through this the glove could get a multiple role, on one hand functioning as a mouse, on the other hand in a given environment it could function as a trigger, perhaps communicating with objects far away. We can see a similar solution in the game *Datura*, which appeared for Playstation 3, but this can only give a limited maneuverability because of Playstation Move controller.

It is well known, that information technology and mathematics are counted to the less liked subjects. As for the

students seeking ways of life is a long process and memories of childhood have the strongest influence on a personality, the appliance of the glove could be useful on music lessons. With the movement of hands teaching of relative solmization could get more interesting, through that it could become a classroom IKT device. It could improve education in the same way interactive boards did.

IV. FRAMEWORK

Those would only be a few useful functions of a general framework, between which the user himself could choose between the most useful options for him, improving his everyday life. How could we make such a framework work? At first, as with every electronic device, some form of initialization is needed, whereby the device gets its default settings, the user would get much more practical settings, instead of the manufacturing settings, which would probably be inconvenient.

As the device is able to detect the position of the fingers, it can be used for the appliance of protection. With this the login password can be replaced with a combination of different movements of the hand.

In order to achieve the easiest usage, the state of the fingers can be divided into two states (bent and outstretched), which results in 32 different hand-signs, so because of that anybody could brake such a kind of "keyboard lock" with the so-called brute-force method. Because of that, we should consider the position of the fingers as binary numbers, as it has two applicable states, this could serve as a solution - as the user would only have to apply the hand-state for a correct detection - that the user would give binary numbers in completely indirect way to reach a proper level of protection. This being extended, by choosing one of 32 sign-combinations it could be possible to being able to choose between a lot of characters with the usage of that sign. After that this can be returned by this chosen sign to enter more numbers. As the input is reasonable conceivable, remembering those codes wouldn't be essentially harder, than in the case of passwords.

These kind of variations could reveal more ideas, because, if we think about it, those combinations can play the role of miscellaneous functions. We could start 32 types of "sub-programs" with the help of our glove, therefrom every option of a function serves to step back to this "menu level".

But if we try to brake out of this necessary, but maybe not adequate frame, we can realize that this was only the "surface". Namely from the first level we can use 32 types, and from the other levels 31 types of appliance. It can be easily realized, that this is combined as an ability-tree, of which the number of elements could be multiplied on each level. Through this it can have a big size even on low levels, because $32 \cdot 31$ options are available just on the second level of the ability-tree.

Orientation between the different levels is a hard, if we would only see the glove in front of us. Presumably even users of gloves with a lot of practice could be unsure which level they are on at that time, on which sub-program of which program they are, what they are doing right now with the

glove. As a result the user has to be told, which level he is stepping into each time.

The most communicating solution would be the notification with signs of sounds or images to the user of the glove. The visual signes could get to the curious looks with the help of some kind of a small graphical inteface.

V. PHYSICAL IMPLEMENTATION

How is it possible to implement all that? It seems appealing to choose existing and inexpensive devices to build that device, which were proved in countless successful projects and would surely be suitable to create a working prototype.

Before that we need to give our product a "soul". This is - even though it probably doesn't seem like it is - rather easy to do, as today's modern technology hives us the opportunity to use excessively inexpensive and fast computers. Of course not desktop computers, nor notebooks or tablet computers are meant by that, but microcontrollers, which are perfectly useable for these kinds of tasks as well. This can for example be an Atmel AVR microcontroller.

But these can not be used by themselves, because the usually just mean an integrated circuit (IC). One of these, probably the most user- and programmerfriendly solution is the Arduino[4], which is a platform-family for development, which is especially built for this scenario. Further kinds of boards are being especially made for a lot of goals and functions, so the shape is made for this case, so that in these special environments they can could be used in the most appropriate way.

The most appealing device for the aforementioned glove-project is the Arduino Board called Lilypad. It's form reflects, that the constructors of it were striving to build the flattest, roundest and smallest device possible. The outlets of it give it the ability to be used properly on experimental circuits as well as at the final stage. Until it is in development, at can be used with the help of crocodile clips, and in an actual project it can be used with special conductive threads, with it additional devices can be fixed on some kind of material or fabric.

We can upload newer and newer programs even millions of times, which can influence the functioning of different and different devices connected to it. They can be written on an integrated development environment (IDE) which is completely open source. For uploading there could be a need for a resetting chip, for this the various FTDI Basic Breakouts, or a CP2102 can be used.

At that time, we get the necessary energy from the computer's inner voltage for the operation of our microcontroller, but this is not an appropriate solution, if we want to mobilize our product. For this we need to applicate a power supply onto our glove as well, so a Lilypad power supply would be used for the supply of a 5V AAA battery.

Our goal is to detect movements of the fingers, for that we can use flex sensors. In the process of bending the fingers the resistance of the sensor is constantly changing. We can use this change of values in various ways. Every function of the glove is based upon the results of the detection of the



Fig. 1. Beta version of the glove

values of resistance, so in this case we don't need to search for cost-efficient solutions. Accuracy should be the first aim. For this task the best sensors would be the sensors (patented technology) manufactured by Spectra Symbol, which were successfully used in the Power Glove built by Nintendo as a video-game-accessory (although the success of this glove didn't depend on the quality of the sensors.)

On the other side the Lilypad doesn't have an infinite number of ports, so we should pay attention to the number of ports, to have enough ports of everything. We avoid the usage of multiplexers.

For the playing of tones we can use some kind of audio board, but those are usually supporting the Uno and Arduino Boards having a similar structure. Besides that it would be hard to make them compatible with the Lilypad and would of course need to much space in vain on our glove. A bridged, good solution could be the usage of a small module, a mini SD-card module, for example the WTV020-SD-16P. We should count on performing a few transformations on it to use it on the glove, but regarding the size and the goal this would be the best solution.

We could see a list of the necessary devices above. This doesn't essentially mean, that it will be enough. The usage of a compass would be useful as well, if we would like to detect movements, in which not necessarily the movements of fingers, but the changing of the position of the arm would be important. Countless movements like this can exist, so it would be nonsense to assume, there couldn't be a need for it. In fig. 1 we can see the beta version of the glove.

An Arduino Lilypad ensures the operation of the prototype of our glove for this system, which has flex sensors attached to it, a compass and a mini SD card module. A Lilypad Power is used to supply the circuitry with power.

VI. FUTURE PLANS

The general system used for the interactive glove could give birth to countless new, imaginative and useful solutions in the future. Their appliance could get popular on a very broad spectrum of users. We could imagine a world, which would result in using systems watching the movements of fingers. Besides the world in front of us getting interactive, we wouldn't

even need to go to the given devices to manipulate subjects or systems, which would make our lives easier. Besides it's usefulness it would have the ability to even store personal data. After some time it would unconcievably integrate in to everyday life, to create new possibilities for us.

An LCD screen will be another part of the prototype, which ensure the easier orientation between the various options in the future, through this making the device more user-friendly.

REFERENCES

- [1] *Ion Wireless Air Mouse Glove* [Online] Available: <http://www.ionwirelessairmouse.com/>
- [2] *EnableTalk* [Online] Available: <http://enabletalk.com>
- [3] *Nintendo Power Glove* [Online] Available: <http://kotaku.com/5900912/nintendos-terrifying-power-glove-indoctrination-video>
- [4] *Arduino* [Online] Available: <http://arduino.cc>
- [5] *Digital Smart Glove* [Online] Available: <http://www.wolftechnical.com/smartglove.htm>
- [6] *T(ether)* [Online] Available: <http://www.origo.hu/techbazis/20120921-3d-tervezes-virtualis-valosagban-az-mitn.html>
- [7] *Piano Hand Glove* [Online] Available: <http://beta.musicradar.com/news/tech/piano-hands-gloves-let-you-play-anywhere-175027>
- [8] K. Ellis, J. C. Barca *Exploring Sensor Gloves for Teaching Children Sign Language* Advances in Human-Computer Interaction, vol. 2012, Article ID 210507, 8 pages, 2012. doi:10.1155/2012/210507
- [9] A. Rega, I. Iacono, A. Scoppa *Magic Glove: An Interactive Hardware/Software System to Animate Objects. An Exploratory Study in Rehabilitation Setting* Como, Italy: IDC, 2009.
- [10] J. Hallam, V. Whiteley *Interactive Therapy Gloves: Reconnecting Partners After a Stroke* Vancouver, BC, Canada: CHI, 2011.
- [11] Cs. Bíró, G. Geda, P. Magyar, R. Szabó *A robotika lehetőségei a tanárképzésben /Robotika laboratórium az Eszterházy Károly Főiskolán/*. Eger, Hungary: MIDK, 2012.
- [12] G. Geda, G. Kovásznai *Using Robotics to Motivate Students in Higher Education* Eger, Hungary: 8th International Conference on Applied Informatics, 2012.