Integration of the future technologies to High schools and Colleges

Primož KURENT, BSc Engineering
ŠC Kranj, Višja strokovna šola, Kranj, Slovenia
kurent.primoz@gmail.com

Abstract

Science and technology are progressing with the speed which seems to be unfamiliar to us. What seems to be science-fiction some 30 years ago is now becoming our everyday reality. 3-D printing, O-led technology, modern communication, smart materials, mind recognition etc. How to follow the progress and all novelties and what is more, how to integrate them into the educational systems of high schools and colleges, is practically an art.

Article addresses the mind recognition system, EMOTIV Epoc technology, and its integration in the educational process.
Mind recognition device EMOTIV Epoc, (https://www.emotiv.com/the-science/) works in way to recognize brain activities in specific brain parts and sends this information to the computer. The computer processes the information and produces appropriate exit signals, whereas by strengthening the latter machines and devices can be controlled. Next to mind recognition, the device also has integrated the gyroscope and system for facial movement recognition.

In ten years such technology could thoroughly change the life of disabled people and the operational working processes in industries, as by controlling the mind, human would be able to control more machines than today by using hands.

Main obstacle for quicker integration in the practical use is the reliability – repeatability. For successful use in industry the rate must be at least 99.5 %, whereas it currently reaches only roughly 70 %.

Key words:

Mind recognition, EMOTIVE Epoc technology, brain activities, future technologies.

I. INTRODUCTION

A constant challenge professors and teacher in school are constantly facing is, how to present new technologies being developed to students, since the main teaching method, frontal method, is no longer effective. Currently prevailing methods are based on practical experiences, where students have the opportunity not only to gain theoretical knowledge, but also to test their own practical skills. We are talking about case studies, team work, and project management approach, whereas the addressed topic needs to be interesting and current.

II. INTEGRATION OF FUTURE TECHNOLOGIES TO HIGH SCHOOLS AND COLLEGES

At School Center Kranj we have thus decided to join the two concepts: we searched for a technology of future (i.e. Mind recognition device EMOTIV Epoc) and integrate it to curriculum by using modern teaching methods (i.e. project and team work), which is also what I wish to address in my article.

A. Mind Recognition Device EMOTIVE Epoc

The brain is a very complex system. The frontal cortex is the part where most of our conscious thoughts and decisions are made and it conducts much less than a tenth of the total activity in the brain.

Planning, modelling of your surroundings, interpretation of sensory inputs up to and including your perception of reality, memory processing and storage and the basic drivers of your moods and emotions all occur in many functional regions distributed around the brain, including the visual cortex at the rear, temporal cortex at the sides, parietal cortex behind the crown of your head and the limbic system deep inside the brain. The limbic system controls your basic moods and emotions, your fight/flight response and deeper long-term memory encoding as well as control of basic bodily functions such as breathing and heartbeat.

Most of these deeper functions interact intimately with different parts of the cortex, the outer layer of which is accessible to EEG measurements, however the interaction is quite complexly distributed. In order to map the true activity of the brain it is very important to measure signals from many different cortical structures located all around the brain surface. It is not possible to map these signals purely from the frontal and temporal regions. Determination of the user's complete mental state is very poorly approximated unless signals from the rear of the brain are also considered.

With proper coverage and electrode configuration, however, it is possible to reconstruct a source model of all important brain regions and to see their interplay [1].

EMOTIV Epoc is a new approach to the design and development of mobile EEG systems. It consists of hardware, which collects data, and software, which analysis the data.

B. Hardware:

The award winning EMOTIV Epoc+ is a 14 channel wireless EEG, designed for contextualized research and advanced brain computer interface (BCI) applications. The EMOTIVE EPOC+ provides access to dense array, high quality, raw EEG data using our subscription based software, Pure EEG (Picture 1).

C. Software: Detection algorithms

EMOTIVE EPOC+ offers different kinds of detection algorithms, all of them built on extensive scientific studies aimed to develop accurate machine learning algorithms to classify and grade the intensity of different conditions.

Facial Expressions – muscle artefact, which commonly get rejected in laboratory EEG studies, are diverted and classified to map the activation in different muscle groups and eye movement events. Our universal detections can be fine-tuned for each individual to indicate 12 different facial expressions or events. Individuals with partial paralysis or unusual musculature can custom-train the activations. These events can be used to animate an avatar, detect specific responses and they may be tasked to execute commands.

Performance Metrics – EMOTIV EPOC+currently measures 6 different emotional and sub-conscious dimensions in real time – Excitement (Arousal), Interest (Valence), Stress (Frustration), Engagement/Boredom, Attention (Focus) and Meditation (Relaxation). Performance Metrics algorithms are being continuously improved and upgraded.

These detections were developed based on rigorous experimental studies involving at least 20-30 volunteers for each state, where subjects were taken through experiences to elicit different levels of the desired state. They were wired up with many additional biometric measures (heart rate, respiration, blood pressure, blood volume flow, skin impedance and eye tracking), observed and recorded by a trained psychologist and also self-reported. EMOTIV Performance Metrics have been validated in many independent peer-reviewed studies [1].

Picture 1

Mental Commands – based on unique and highly efficient methods, EMOTIV has developed a system for users to train direct mental commands where the user trains the system to recognize thought patterns related to different desired outcomes, such as moving objects or making them disappear. The system can be trained to recognize a single command in less than 20 seconds.

EmoKey – the custom software allows untrained users to be able to link their mental commands and emotional reactions directly to keystrokes, mouse operations or gestures within the host machine, allowing non-programmers to incorporate mental commands and mental state detections directly into existing applications.

Combined with the on-board motion sensor it can provide a hands-free brain-controlled mouse, adjust music volume or track skip depending in mood, and many other options.

D. Integration of the future technologies into learning process (curriculum)

Mechatronics is a new science combining engineering, electrical engineering and computer science. We wished to include the technology of the future EMOTIVE Epoc as cross-curricular connector during Mechatronics classes. Since this is a rather complex process, we integrated it through project work.

Project work, however, requires exact definition of goals, activities, sources and timeline [2]. We approached to realize our goals through the following phases:

- Task definition,
- Allocation of groups,
- Timeline,
- Conceptual design,
- Plan creation together with description of working, materials etc.
- Device making,
- Device testing,

Task definition:

Aim of the task was to create a mobile robot (car), which will be mind-controlled:

- Mobile robot (car),
- Size: length cca. 70 cm,
- Carbon made,
- Functions: forward, backward, left, right
- Additional functions: facial expressions recognition (with LED we show ☺, ☹), steering with gyroscope,
- Autonomous functioning (battery charged),
- Wireless connection with a computer,
- 4 wheels.

Allocation of groups:

We divided the project to four lots, whereas each lot is being led by one of the professors – mentors.

- 1st Lot: Computer science (Mentor Andrej Arh),
- 2nd Lot: Electrical engineering (Mentor Jožef Polak),
- 3rd Lot: Mechanics (Mentor Aljaž Rogelj),
- 4th Lot: Project Management (Primož Kurent).

Timeline

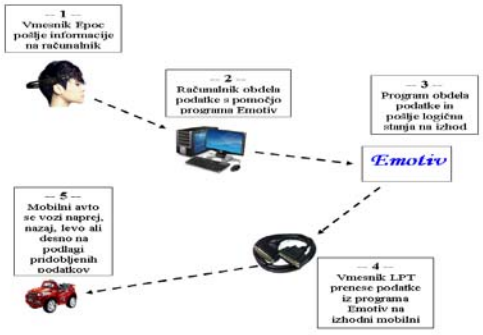
Well prepared timeline of the corresponding activities, responsibility allocation and costs management is main foundation of successful execution of a project.

Conceptual design

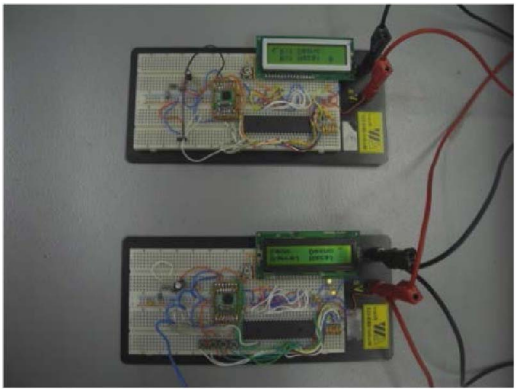
As aforementioned the EMOTIV Epoc senses the brain activities and only transfers to the computer the signals which require further analysis. Such program was written by students. With the help of one of the soft wares, the computer can be taught which impulse (brain activity) means which order (e.g. forward, backward etc.). Using wireless, the computer then sends the order to the vehicle. The vehicle holds a recipient, which strengthens the signal and sends it to electro engine, causing the vehicle to move. (see Picture 2: Scheme of components connection).

1st Lot: Computer science (Mentor Andrej Arh)

The computer science group studied the functioning of the mind recognition device EMOTIVE Epoc, with installed gyroscope and facial movement recognition system. The signals, which EMOTIVE Epoc transmits, were changed by a software program designed by students, to the extent that they can be transmitted to the computer holding the wireless data transfer system. This system was developed by the electrical engineering group.



Picture 2: Scheme of components connection.



Picture 3: Device for wireless data transfer.

2nd Lot: Electrical engineering (Mentor Jožef Polak)

The electrical engineering group developed a system for wireless data transfer. (Picture 3: Device for wireless data transfer.) [3]. The system has four different speeds, based on the number of signals. In practice this means, if we think "forward", this represents speed 1, if we think "backward", this is speed 2, etc. The same logic applies for the gyroscope: when we move head forward, this is Speed 1, if we move it forward again this is again another speed etc., whereas if we move our head backward, this reduced the speed level.

3rd Lot: Mechanics (Mentor Aljaž Rogelj)

The mechanics group had to develop a physical model of the vehicle. The vehicle is made out of carbon fibres, representing another challenge on its own Student Luka Kondič is well skilled in vehicles design and he drew a roadster sketch (Picture 4: sketch of the vehicle), after which a 3D model was designed with the help of a computer. To produce the vehicle we first needed to make a model out of Styrofoam in the scale 1:1. This model was made with the help of the School Center Celje. Later on, we applied carbon and resin to the model which gave us the vehicle model as seen on Picture 5: Vehicle made out of carbon. The physical model was made by a student with the help of company Fanell, d.o.o..

III. CONCLUSION

In the article I presented a new, innovative approach of integration of future technologies in high schools and colleges. We developed a mechatronic device steered with by human mind.

Picture 4: sketch of the vehicle.

Picture 5: Vehicle made out of carbon.

The system entails a device which is being put to a person's head and recognizes the electrical impulses from brain when we think of a certain thing/object/feeling. These impulses can be transmitted to a computer and processed accordingly. We can form exits which manage different actuators. This gives us endless possibilities to develop new and interesting devices which are mind controlled. The device also holds a gyroscope and has the possibilities of facial activities recognition.

Knowledge and experiences which we gained with this project brought us to a level, where we practically have endless possibilities for various applications in the future; from medicine to mechanical and entertainment industries.

All involved participants learned something new in this project. Talented students, full of interests, gained new skills and insights into industry, whereas mentors gained new pedagogical and professional skills. It was a great pleasure to work with students full of enthusiasm, which also brings quality and promotion to the school.

I believe that such projects are necessary in the future and this is why we will proceed with such successful practice also in the upcoming years.

LITERATURE

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