

Universal Arduino-based experimenting system to support teaching of natural sciences

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Abstract. The rapid evolution of intelligent electronic devices makes informatics, computer science and electronics strongly related to the teaching of natural sciences. Today practically everybody has a smart phone that can convert light, temperature, movement, sound to numbers, therefore all these can be processed, analyzed, displayed, stored, shared by software applications. The fundamental question is how can we apply the principles of operation of such modern devices to help the students to develop comprehensive knowledge. Here we report about our related solutions developed for the popular Arduino board to support exciting teaching of physics and many other disciplines.

1 Modern devices in education

More and more devices around us are based on electronics and operated by software running on its internal processor. They use sensors to translate real world signals to numbers that allows information processing and as a result, acting on the real world objects. Home appliances, medical devices, industrial and commercial robots, smart phones, autonomous cars represent a wide range of examples. It is clear that education must be influenced by this in various ways. However, it seems to be rather difficult to follow the rapid development of technology.

On one hand, modern tools can support visualization, can serve as components to build even a robot or other exciting device very easily. On the other hand, it is not evident that students can understand such a modern world around them, one may think that there are even more “black boxes” in education than before. However, the main principles can be surprisingly universal and similar in distant fields. Extracting and applying these can help to develop comprehensive and confident knowledge by an exciting and inspiring experimenting learning environment.

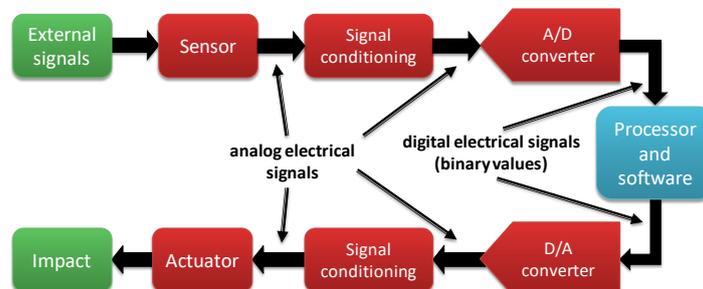


Fig. 1 Main components of a general modern electronic device

Fig.1 shows the main components of a modern device. For example, in a smart phone the sound can be sensed by a microphone whose output signal is handled by some electronics to provide voltage that can be converted to a sequence of numbers. These numbers than can be processed by software – just think about speech recognition common in many apps. The signal chain can be reversed: the result of information processing can generate real world signals. The

device can talk, vibrate or make light. It is easy to see, that the same principles apply to living things. Humans can see, so sense light and can process the information and as a result of thinking they can make movements or emit sounds. Software operated devices are often called smart, they are “taught” by programmers – just a similarity with education process.

2 The EDAQuino system

In order to support the visibility and application of the most general and fundamental principles in an educational environment we have developed an extension board for Arduino to implement our previous educational system called EDAQ530 [1,2], see Fig. 2. The system allows the connection of many different sensors and supported by a very universal signal processing and displaying software. However, the real advantage is that the system is very transparent, the students can see how the sensors are used in an electrical environment, how math should be applied to get the required quantities, how to deal with digitized signals. Many experiments can be performed, from detecting the period of a pendulum to monitor the blood flow in the finger just with the same system and software. It is scalable, it can be used for demonstration by the teacher, can be used by students in experiments, but student can even write their own programs.



Fig. 2 On the left: EDAQ530 and EDAQuino with various sensors. On the right: EDAQuino measures blood flow in a fingertip.

3 Conclusion

We have developed an experimenting teaching system that applies the most fundamental principles of modern devices in a transparent way. Due to the very popular Arduino basis, it is widely available, has very low price, anybody can build the simple extension electronics on a breadboard. The same system can be used for an extremely wide range of experiments. Additionally, even the application methods of modern technology are taught. In our talk we'll demonstrate the capabilities of the solution by experiments from different fields.

Acknowledgements

This study was funded by the Content Pedagogy Research Program of the Hungarian Academy of Sciences.

References

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