Mag-Timer : Computer Controlled Magnetic Reed Timer

Students
Zeicu Claudia Ioana Maria
Schipor Ioana

Supervisor
Sinan Kosak

THE INTERNATIONAL COMPUTER HIGH SCHOOL of CONSTANTA
ROMANIA

Table of Contents

1. ABSTRACT……3
2. INTRODUCTION……4
3. MATERIALS ……4
4. METHODS ……5
5. RESULTS……7
6. DISCUSSION……7
7. CONCLUSION……8
8. ACKNOWLEDGMENTS……8
9. REFERENCES……8

ABSTRACT

The effect of computer assisted instruction (CAI) on students' achievement in science experiments is proved to be a positive enhancement in learning. When CAI is combined with practical experiments it results in better achievements. But the cost of computer based devices is a real barrier for most of the schools especially in rural areas.

The purpose of this project is to provide a cost-effective multifunctional timing device to be used in physics experiments for schools that cannot afford the commercial alternatives of data loggers.

Mag-Timer can be used to take time based measurements from class experiments that involve measuring time, speed, and acceleration of a moving object, the reaction time of a person, and measuring the period of simple oscillations. The computer program needed to control the Mag-timer and to calculate the experimental data is written originally by us in C-sharp programming language. The materials that we used are magnetic reed switch, parallel port connector and a small bar magnet which will cost around 5 $. Commercial photogates with electronic timer or special software costs around 1000 $. (Vernier TM interface with 2 photogates, sensor and software costs 825 $ without shipping and customs tax).

In conclusion, this device is a real challenge for us to improve ourselves in programming and electronics. The output of the project and its positive effect on students' understanding of physical concepts is a great motivation for us to develop and distribute freely to schools in need.

INTRODUCTION

The purpose of this project is to design and build an alternative data logging device that can easily take time based measurements from class experiments.

While we were at physics hour, we realized how lucky we are that our school have enough budget to provide us many expensive equipment that can help us understand physical phenomena. Our teacher is using experiments to make the lessons more interesting and understandable. Seeing how much 9th graders were fascinated by mechanics experiments and taking into account how much we learned from the experiments last year using photogates and data loggers, we decided to build a cost-efficient alternative device that many schools can afford and use easily in physics experiments.

Our research is based on knowledge of electronics and programming. We think that this technology will help not only students to be involved in lesson activities but also teachers to deliver their subjects more efficiently.

MATERIALS

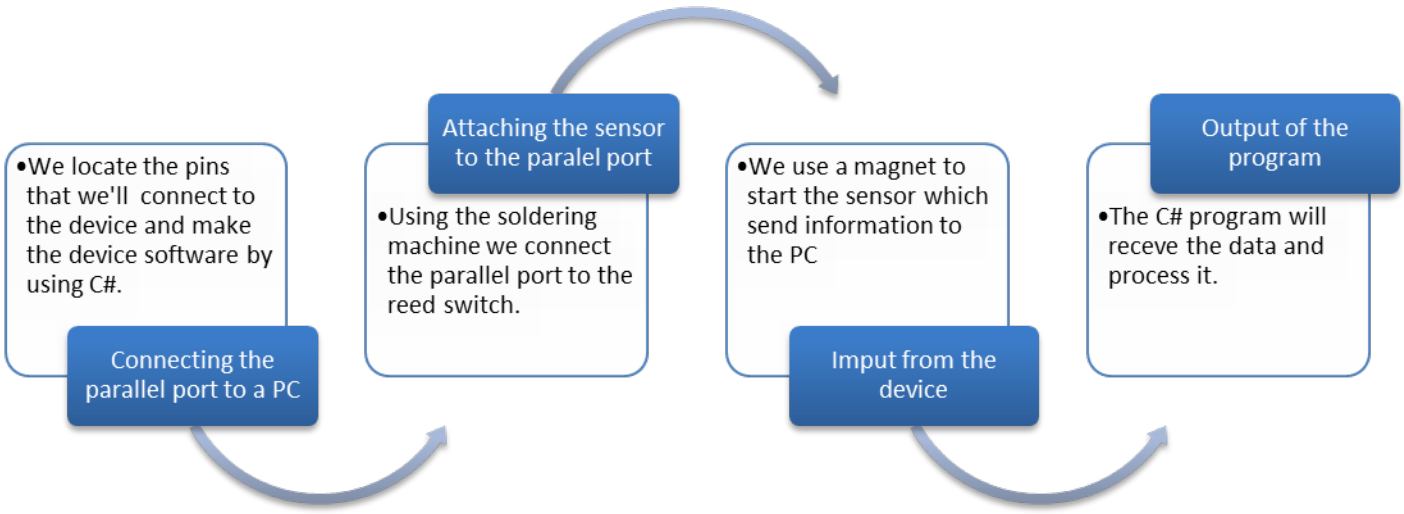
In order to construct the Mag-timer we used a magnetic reed switch, thin connecting wires, parallel port connector, magnets and a notebook computer. To test the device we used an LED, a resistor, Vernier™ data logger, photogate and software.

The **reed switch** is an electrical switch operated by an applied magnetic field. It consists of a pair of contacts on ferrous metal reeds in a hermetically sealed glass envelope. The contacts may be normally open, closing when a magnetic field is present, or normally closed and opening when a magnetic field is applied.

A **parallel port** is a type of interface found on computers for connecting various peripherals. **A parallel port connector** can be found on a parallel port printer cable with a 25 pins DB male connector at one side and a 36 pins centronics connector on the other.

A **magnet** is a material or object that produces a magnetic field. This magnetic field is invisible but is responsible for the most notable property of a magnet: a force that pulls on other ferromagnetic materials like iron and attracts or repels other magnets.

METHODS



1. First we learned more about parallel port interface and how to use it to communicate with the computer. We located the input, output and ground pins of the parallel port connector and soldered leads with different colors.
2. We used some free test programs found on electronics hobby books and their sites to test the connection with the LPT port of the laptop computer.
3. Afterwards, we connected the other end of the wires from the parallel port to a magnetic reed switch by soldering.
4. We again verified the output of the pins by using various programs to see if the computer receives data from the parallel port. We also tested to see how we can send data to the parallel port.
5. Next, we started to work on writing the codes in C#. After many trials and with little help from our programming teacher we could successfully compose our own computer program that can basically start and stop the stopwatch to measure a time interval when the magnetic reed is switched on and off by a magnet nearby.
6. We verified the output by conducting an experiment with the oscillation of a simple pendulum. We modified the program to measure and display the period of a simple pendulum.
7. After we saw that the program works we added another reed switch to the parallel port and modified the program to get input from two sensors.
8. We optionally connected an LED with a resistor to the input pin of the connector. We wrote the codes to control the LED light in order to use it in reaction time experiments.

RESULTS

Our project is still in a process of development, and will be further updated. We made the most part of the project, and we are still working on making the device more portable, developing the computer user interface, and preparing the experiments manual.

We also do experiments to compare the measurement results to the results obtained with commercial data loggers. An experiment to measure the period of an oscillation of a simple pendulum was our first choice. We compared the results to the Vernier™ photogate sensor.

	MagTimer	Vernier phptogate
The time of a half oscillation measured	0.63	0.635
The time of a full oscillation calculated, Period	1.26	1.27

DISCUSSION

We found out that the results with Mag-timer and Vernier™ Photogate are almost the same indicating that Mag-timer is a good alternative. We showed that the accuracy we obtained from sample measurements were high enough to conduct physics experiments in schools.

We learned that the distance to the magnetic sensor and the magnet attached to the moving object or the other magnetic materials around the experimental apparatus should be adjusted carefully to eliminate false timing.

In the near future, we hope to rebuild the Mag-timer using the more popular USB-port connection instead of the parallel port.

CONCLUSION

Mag-Timer can be used to take time based measurements from class experiments that involve measuring time, speed, and acceleration of a moving object, the reaction time of a person, and measuring the period of a simple oscillation.

In conclusion , the experiments we tried show that the Mag-timer works well and it can be distributed as an alternative technology to schools that don't have enough budget to buy the commercial alternatives.

ACKNOWLEDGEMENTS

In our research, our physics teacher, Mr. Sinan Kosak, provided us the electronic equipments of our school and suggested electronics books. For the software part, our programming teacher , Mr. Ali Cabas , helped us with C# language.

REFERENCES

In our research we used different resources such as:

- http://en.wikipedia.org/wiki/Reed_switch : We used this link to read more information about a reed switch.
- http://www.epanorama.net/circuits/parallel_output.html : This site explained us how to connect the parallel port to the computer and using http://www.labbookpages.co.uk/electronics/parallelPort.html we understood what pins to connect .
- http://www.elektronikhobi.com Sample applications to test input/output of parallel port programming.