INNOVATION OF GRAVITATIONAL ACCELERATION MEASUREMENTS

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ABSTRACT

This contribution describes new system for measuring gravitational acceleration. New hardware setup and software were created according to known new technologies. Software is user friendly and is there more space for own results elaboration.

1 INTRODUCTION

The main purpose of the course physical laboratory is acquaint listener with fundamental physical law practically. With this object is in laboratory installation exercise with title gravitational acceleration. Students measure gravitational acceleration on basis knowledge period of physical pendulum oscillation. The period of oscillation was formerly measured by DMP 01 instrument.

Signals for measuring oscillation period was derived from interruption light beam of sensor by pendulum movement. The sensor consists of two tubes. In the first tube is inserted source of the light. In the second tube is detector (phototransistor). The signals from detector are processing in DMP 01. This instrument allow set a number of measured oscillations and show period time on display. Measured data was processing by special program on the computer.

2 GRAVITATIONAL ACCELERATION MEASURED METHOD

Gravitational acceleration is measured by reversing pendulum. Oscillation period T of mathematics pendulum is given by:

$$T = 2\pi\sqrt{\frac{l}{g}} \tag{1}$$

where l is length of pendulum and g is gravitational acceleration. The length of mathematical pendulum, which pendulate with the same oscillate period as physical pendulum, is called reduced length of physical pendulum. If we known the reduced length and oscillation period of physical pendulum we can use this equation for gravitational acceleration calculation:

$$g = \frac{4\pi^2 l}{T^2} \tag{2}$$

It is possible to improve that distance between axis O_1, O_2 (Fig. 1.) is equal to reduced length of used physical pendulum in case of same oscillation period around both axis ($T_1 = T_2$). To achieve this condition we must find a right position of bob. Pursuant to our knowledge (distance between axis O_1 and O_2, oscillation period of physical pendulum) we are able to calculate gravitational acceleration (2).

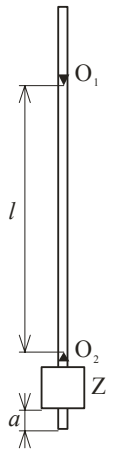

Fig. 1: *Physical pendulum*

3 INNOVATION

Due to expansion number of workplaces from 2 to 6 we had to construct a new system of measurement which would be more useful. Multiplication of current instrument DMP 01 is not effective because of usage an archaic component base and general economic conditions.

The right solution of this problem consisted in innovation of computer program. The new version of the program picks over the function of DMP 01 instrument. Electronic circuit is designed only for detection interruption of the light beam in time domain. Schema of new circuit is shown in Fig. 2.

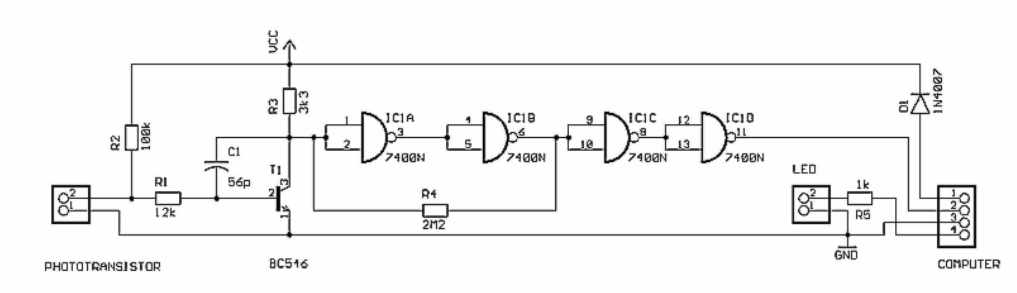

Fig. 2: *Electronic circuit scheme*

The detector of the light is phototransistor again. The level of the incident light control output signal of the IC1 gate D. This signal is connected to pin CTS of the RS232 interface. Pin DTR serves as power for described circuit and pin RTS control the LED.

The electronic is placed on printed circuit board and is situated inside of the light gate detector tube. Mechanical setup is shown in following Fig. 3.

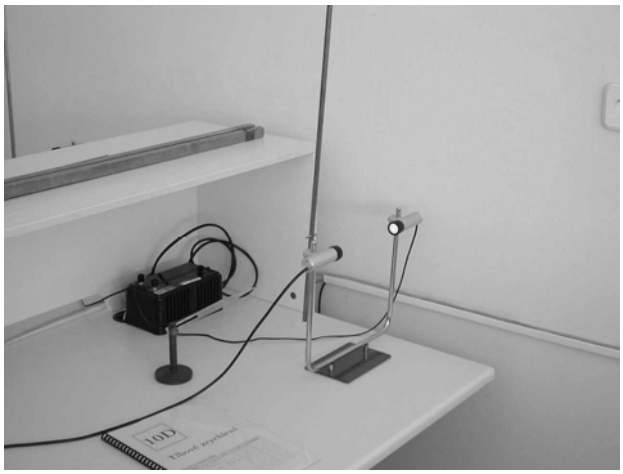

Fig. 3: *Light gate detail*

4 SOFTWARE EQUIPMENT

Program Kmit® is 32bit multi dialog interface application for all operating systems Windows older then Windows 3.11. Fig 4 shows program preview.

To start the program the student must fill in personal data as name and identification of study group. Students choose the number of measurement and then complete the first column of table 1. The measurement of twenty oscillation period is started up by double click on empty cell in table 1. After finishing the first part of measurement is possible to obtain the chart of dependence oscillation period on bob's position. Now student must set the right position of the bob and continue by measurement sequential method. All measured data could be printed or saved as a file. On the base of this experiment is able to determine the gravitational acceleration.

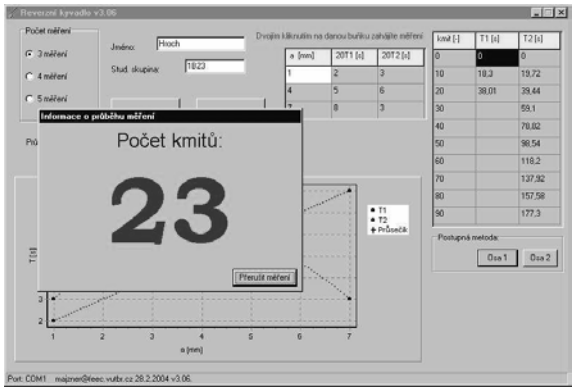

Fig. 4: *Program Kmit® screenshot*

5 SUMMARY

Due to high number of students is necessary to ensure functionality of all installed workplaces. To reach this intention is important to renovate all old equipment according to new known technologies. The new created system allows students better understanding of physical laws during the lab practise. Software is user friendly and is there more space for own results elaboration.

Fig. 5: *Program in action*

ACKNOWLEDGEMENTS

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REFERENCES

[1] Uhdeová, N.: Fyzikální praktikum, Brno, PC-DIR Real 1995, ISBN 80-214-1521-5