COMPLEX STUDENTS'S EXPERIMENTS CARRIED OUT WITH THE HELP OF A SMART PHONE

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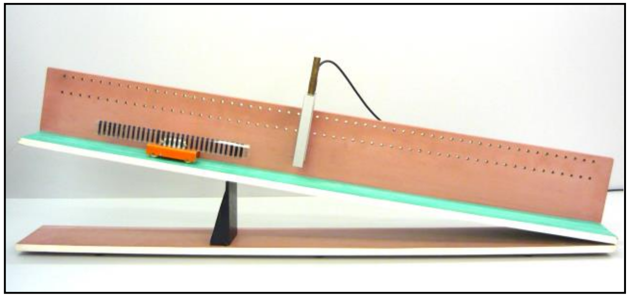
Teaching Physics Innovatively 2015

- *Kinematics* is an essential material
- Methods of *tracing of motion*

→ the *classic* methods and new *modern* techniques



The crucial role of physics experiments

→ "engine" of the research

→ practice deepen and stabilize

→ acquiring proficiency

→ developing practical skills

→ activity of students

- *The second Győr Science Festival*
- *Project-Based Learning (PBL)*

→ the focus is on the student

→ motivation

→ cooperative work skills

→ coordinating and moderating role of teachers

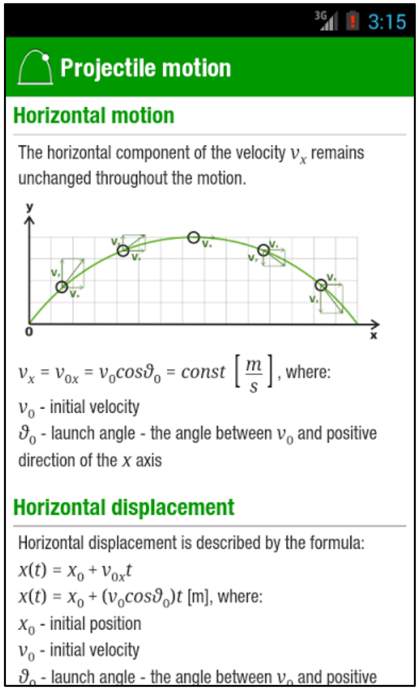
→ interdisciplinary characterization

Mobile devices

- „Not without my mobile!”
- integral part of the daily lives
- the „digital natives”
- a new challenge of teachers
- integrate into classroom instruction

Databases and applications

- the Electro Droid and the Periodic Table
- scientific calculator functions
- *the Pocket Physics*
- Microphone
- the Sound Meter
- the FrequenSea Analyzer

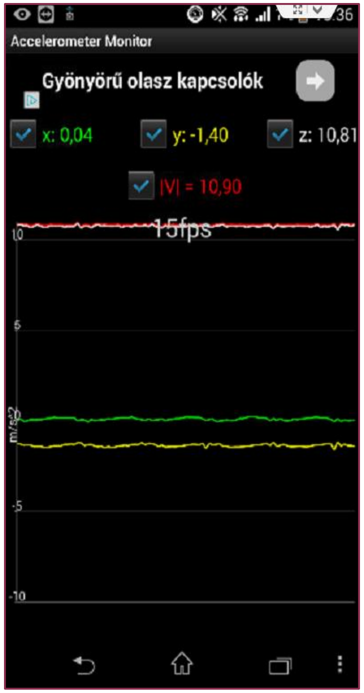


The three-axis accelerometer sensor

- calculate the extent to which the phone is tilted
- determine the direction of gravitational acceleration
- rotation of the screen view
- the phone can be fixed to a small cart
- the phone can be placed on a vibrating or rotational systems
- export the measured data or do screenshot

Determine the telephone acceleration sensor location!

- examine uniform circular motion in real context
- use a record player (30 cm in diameter)
- *Used application*: Accelerometer Monitor
- *Phone type*: Sony Xperia SP

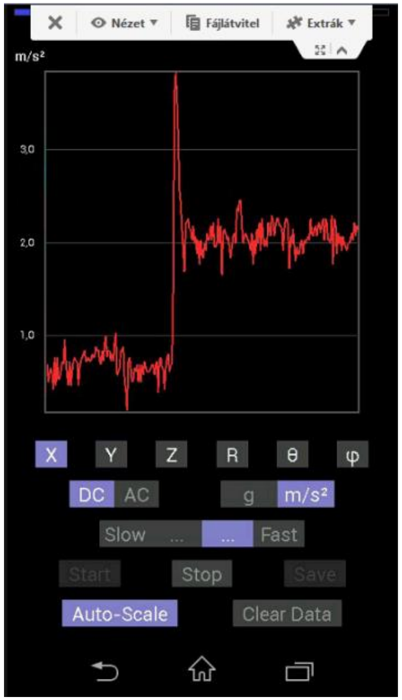


- the upper curve shows the measured data of the perpendicular to the axis of the figure
- in the middle the curve represents the tangential component of the acceleration of circular motion
- the bottom sequence gives the radial component of the acceleration

- If we know the number of rotation, we can specify the angular speed (ω)

- The distance R of the revolving sensor from a central axis can be calculated as follows:

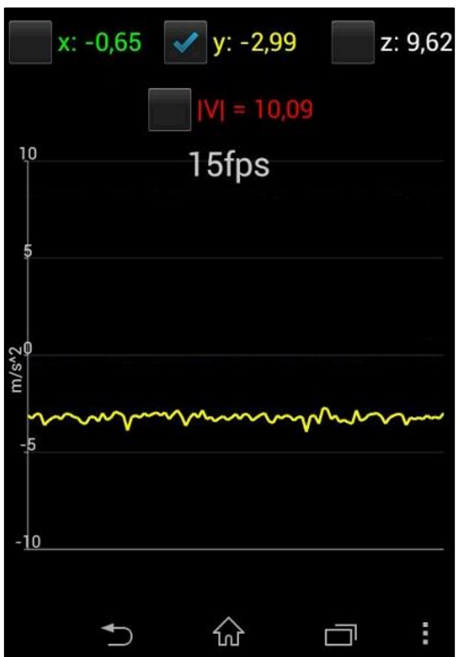
$$a_{cp} = R\omega^2 \rightarrow R = \frac{a_{cp}}{\omega^2}$$

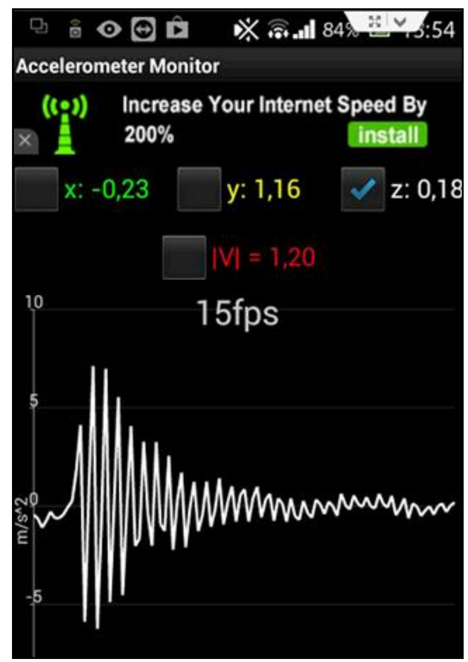


Uniform circular motion
with different frequences


TECHNOSTAR
2015/08/05


2015/08/05

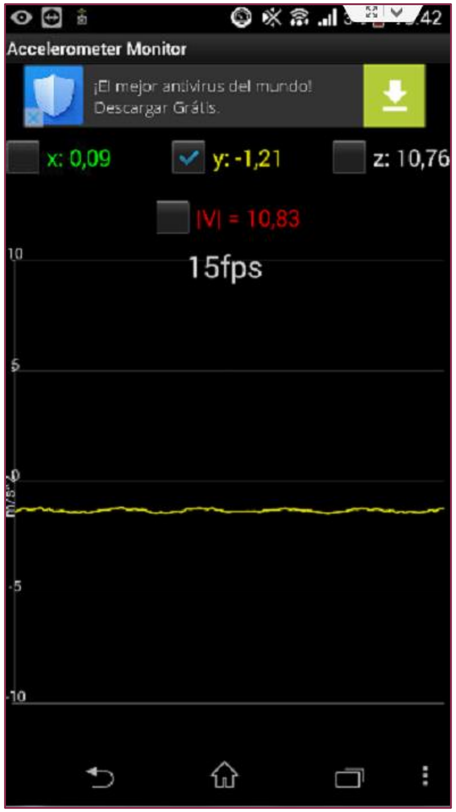

x: -0,65
y: -2,99
z: 9,62
|V| = 10,09
15fps
10
5
0
-5
-10
m/s^2


Accelerometer Monitor
Increase Your Internet Speed By 200%
install
x: -0,23
y: 1,16
z: 0,18
|V| = 1,20
15fps
10
5
0
-5
m/s^2

$$n = 45\ \frac{1}{min} \quad \rightarrow \quad f = 0{,}75\ \frac{1}{s}$$

$$\omega = 2\pi f = 4{,}71\ \frac{1}{s}$$

$$a_{cp} = R\omega^2 \rightarrow$$

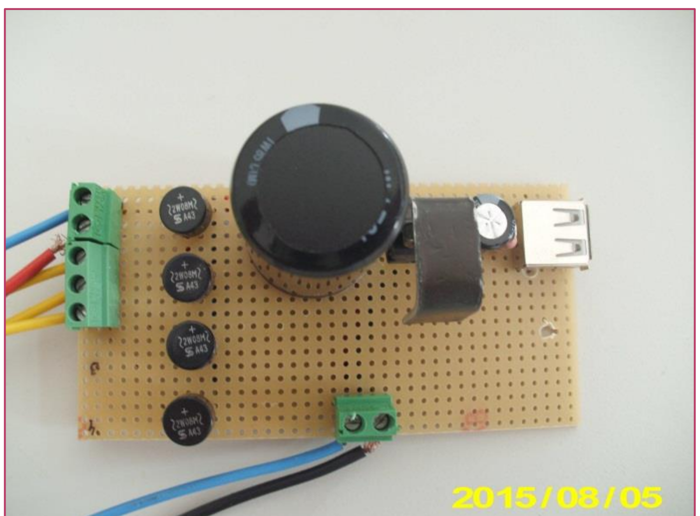


$$R = \frac{a_{cp}}{\omega^2} = \frac{1{,}25\,\frac{m}{s^2}}{(4{,}71\,\frac{1}{s})^2} = 0{,}056\ \mathrm{m} = 5{,}6\ \mathrm{cm}$$

Other additional tasks

- Determination of the spring constant
- Determination of the damping characteristics
- Definition of inertia
- Determination of resonant frequency
- Determination of acceleration due to gravity

A mobile phone was charged up with the help of 4 simple dynamos mounted on a bicycle and the necessary direct voltage was powered by 4 Graetz-bridges and the surplus current was used for operating a toy railway.



Conclusion

- particularly suitable for working in special students workshops or advanced level classes
- give the figures for students as homework
- a great advantage: it’s always in our reach
- the device doesn’t replace a well-stocked physics store room but only compliments it

Special thanks for the help

Péter Tasnádi

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- *my students:* Zalán Balhási
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Thank you for your attention!