ELECTRICAL PORTABLE SEISMOGRAPH (EPS)
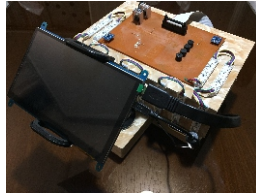
Mahyar Salamati, Kamal High School, Tehran/Iran, m.salamati2015@gmail.com

A R T I C L E   I N F O

A B S T R A C T

A seismometer is an instrument that measures motion of the ground, caused by, for example, an earthquake or a volcanic eruption. The data that is recorded by a seismometer are plotted by a seismograph. "EPS" as a portable seismograph and also a seismometer works by using electrical methods with some unique systems which make it different from others, such as earthquake prediction, Smart alert, online network, auto upgrade and online recording systems. By using physics laws the data are analyzed then it can help geological centers by network connections.

1 Introduction

"EPS" –Electrical Portable Seismograph- consists of some electrical components that help it to receive different data about earthquake and analyze them for geological centers and usual people (Fig.1). It is user-friendly, so can be used by the majority of people. "EPS" has many methods to use it in different situations such as home scale or national and international scales, also because of using electromagnetism receiver plates it can predict earthquake and by its smart alert system, alerts people and geological centers.

Fig. 1: Electrical Portable Seismograph, EPS

2 Materials

Items that are used in EPS:
- ATMEGA 2560
- Raspberry PI 3 Model B
- 7" LCD
- ADXL335 –acceleration sensor-
- LEDs (RED, Yellow and Green)
- Buzzer
- High and Low weight plate
- Spring in 2 sizes
- 2*8 LCD
- Main board

3 How does EPS work

As the figures show, EPS has four ADXL335 that are connected to first plate using small springs, then sensors are connected to microcontroller, ATMEGA 2560, to receive the pulse of the sensors and sense the vibration and record the data. It has a module includes a buzzer and LED's that each color of LED shows a range of vibration (1-3 R: Green, 3-5 R: Yellow, 5<: Red). This module is being controlled by the microcontroller, after that data are sent to a Raspberry PI 3 to be analyzed and the graph will be shown by using main LCD. Also Raspberry PI 3 can be connected to internet and share all data and graph on the net and make whole system online that help EPS to alert all people especially the people nearby to save their life.

4 Smart Alert System (SAS)

EPS supports a smart alert system; consisting of some different parts. EPS can automatically diagnose what range the magnitude is to alert people and due to the magnitude EPS uses LED (Blue, Green and Red), Sound waves, app notification on mobile phones and online alert system. The algorithm works in a way that makes EPS to alert people and geological centers for all ground's movements and records data for more information. Here is the algorithm of the SAS (Fig. 2).
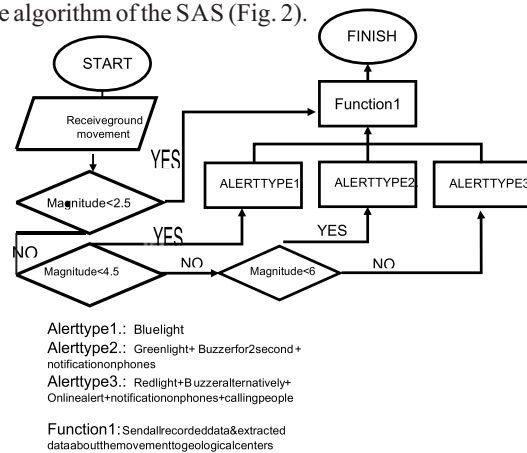

Alerttype1.: Bluelight
Alerttype2.: Greenlight+ Buzzerfor2second + notificationonphones
Alerttype3.: Redlight+Buzzeralternatively+ Onlinealert+notificationonphones+callingpeople

Function1: Sendallrecordeddata&extracted dataaboutthemovementtogeologicalcenters

Fig. 2: The algorithm of the SAS

5 Experiments and Results

Ground movements in an earthquake has three different directions and each of them has an important role in seismic information. EPS can extract these data and plot the graphs in each direction separately. Different experiments have been done to record data and analyze them by EPS.

5-1 Released Energy

Released energy has been recorded by dropping a 5-kg block from different distances on different floors by EPS and using formulas and the comparison between them –real data and recorded data by EPS- can show us the accurate of Electrical Portable Seismograph (Fig.3 a-c).
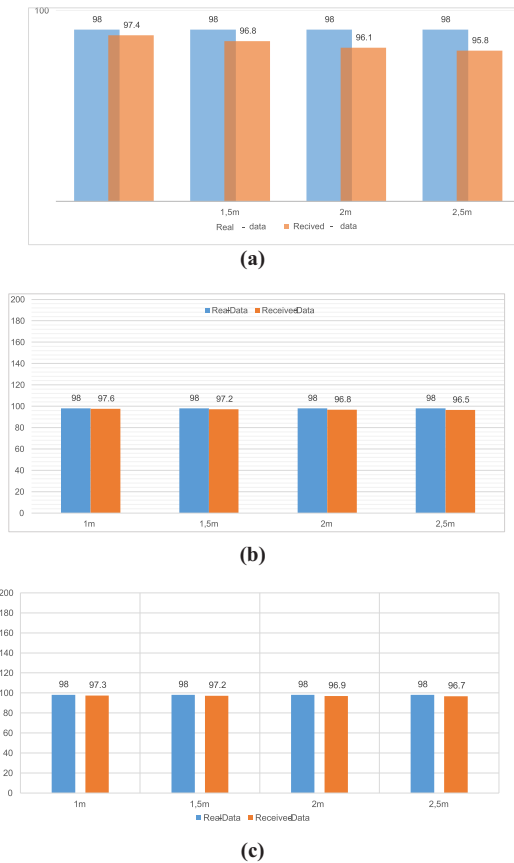
(a)

(b)

(c)

Fig. 3: Released energy comparison of real data and recorded data by EPS, a) wooden floor, b) Metallic floor, C) Rocky floor

5-2 Spring's Length

Changing the spring's length can transfer the energy from earth to EPS so for each device, using a special spring can transfer and amplify energy of the movement more accurately.

5-3 The plates

MDF plates in this device has an important role, so physical properties of the plates such as weight, size, thickness and springs' attachment place, and also how much the plate is sticky, are the important factors to support weight in this experiment.

6 Conclusion

EPS has the best function when is used in a large-scale, then it can specify the earthquake focal point just after the vibration. Then the network system in EPS helps it to improve itself automatically. EPS can find an algorithm about the earthquake history and the ground movement in years too.

Effective variables on EPS accuracy are as follow:

-Diameter Of spring

-spring length

-Sensor sensitivity

-Support weight

-Number of springs

- Conductivity of wires

References

[1]   Tavakoli S. , 2004. Seismology.Payam Noor University. 551.2

[2]   Alizadeh A., 2013. Active faults on the satellite image of Azerbaijan Province, northwestern Iran, Geoinfor Geostat: An Overview, 1:3.

[3]   Djamour Y., Vernant P., Nankali H. R. & Tavakoli F., 2011. NW Iran-eastern Turkey present-day kinematics: Results from the Iranian permanent GPS network, Earth and Planetary Science Letters 307: 27–34.

[4]   Bailey D. H., Swarztrauber P. N., 1994. "A fast method for the numerical evaluation of continuous Fourier and Laplace transforms"

[5]   Boashash B., 2003. Time-Frequency Signal Analysis and Processing: A Comprehensive Reference, Oxford: Elsevier Science, ISBN 0-08-044335-4.

[6]   Aki K., Richards P. G., 2002 .Quantitative Seismology by , University Science Books; 2 edition .

[7]   Lee W.H.K.; Jennings P., Kisslinger C., Kanamori H., 2002. International Handbook of Earthquake & Engineering Seismology. Academic Press. pp. 283–. ISBN 978-0-08-048922-3.

[8]   Robert R., 2012. Earthquakes and Engineers: an International History. Reston, VA: ASCE Press. pp. 122–125. ISBN 9780784410714.

[9]   Kent F.A., John L.C., Christopher S.D., Robert P.A., 1993. Earthquake Locations Determined by the Southern Alaska Seismograph Network for October 1971 through May 1989 (Report). USGS.

[10]   Wielandt's E., 2010. Seismic Sensors and their Calibration'Archived at the Wayback Machine.- Current (2002) reference by a widely consulted expert.