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October 22, 2015

Inna Muara Hotel and Convention Center Padang, Indonesia

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The International Conference on Mathematics, Science, Education and Technology

(**ICOMSET 2015**)

Education, Mathematics, Science and Technology for Human and Natural Resources

October 22, 2015

Inna Muara Hotel and Convention Center Padang, Indonesia

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Organized by

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Message

from the

Rector of State University of Padang

Ladies and Gentlemen,

It give me great happiness to extend my sincere and warm welcome to the participants of the International Conference on Mathematics, Science, Education and Technology (ICOMSET 2015). On behalf of Universitas Negeri Padang, let me welcome all of you to the conference in Padang, West Sumatra Province, Indonesia.

We believe that from this scientific meeting, all participants will have time to discuss and exchange ideas, findings, creating new networking as well as strengthen the existing collaboration in the respective fields of expertise. In the century in which the information is spreading in a tremendous speed and globalization ia a trend. Universitas Negeri Padang must prepare for the hard competition that lay a head. One way to succeed is by initiating and developing collaborative work with many partners from all over the world. Through the collaboration in this conference we can improve the quality of our researches as well as teaching and learning process in mathematics, science and technology.

I would like to express my sincere appreciation to FMIPA UNP and organizing committee who have organized this event. This is a great opportunity for us to be involved in an international community. I would also like to extend my appreciation and gratitude to keynote speakers and participants of this conference for their contribution to this event.

Finally, I wish all participants get a lot of benefits at the conference. I also wish all participants can enjoy the atmosphere of the city of Padang, West Sumatra.

Thank you very much

Prof. Dr. Phil. Yanuar Kiram Rector

Message

from the

Dean of Faculty of Mathematics and Science State University of Padang

Rector of State University of Padang Vice-Dean of Faculty, Mathematics and Science Head of Department in Faculty of Mathematics and Science Distinguished Keynote Speakers Organizers of this conference Dear participants Ladies and gentlemen

I am delighted and honored to have this opportunity to welcome you to ICOMSET 2015 - the International Conference on Mathematics, Science, Education and Technology, which is hosted by Faculty of Mathematics and Science, State University of Padang.

As the Dean of Faculty of Mathematics and Science, I wish to extend a warm welcome to colleagues from the various countries and provinces. We are especially honored this year by the presence of the eminent speaker, who has graciously accepted our invitation to be here as the Keynote Speaker. To all speakers and participants, I am greatly honored and pleased to welcome you to Padang. We are indeed honored to have you here with us.

The ICOMSET organization committee and also the scientific committee have done a great work preparing our first international conference and I would like to thank them for their energy, competence and professionalism during the organization process. For sure, the success I anticipate to this conference will certainly be the result of the effective collaboration between all those committees involved.

This conference is certainly a special occasion for those who work in education, mathematics, science, technology, and other related fields. It will be an occasion to meet, to listen, to discuss, to share information and to plan for the future. Indeed, a conference is an opportunity to provide an international platform for researchers, academicians as well as industrial professionals from all over the world to present their research results. This conference also provides opportunities for the delegates to exchange new ideas and application experiences, to establish research relations and to find partners for future collaboration. Hopefully, this conference will contribute for Human and Natural Resources.

I would like to take this opportunity to express my gratitude to all delegates and sponsors for their full support, cooperation and contribution to the ICOMSET 2015. I

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also wish to express my gratitude to the Organizing Committee and the Scientific Committee for their diligence. The various sponsors are also thanked for their kind support.

In closing, I realize that you are fully dedicated to the sessions that will follow, but I do hope you will also take time to enjoy fascinating Padang, with its tropical setting, friendly people and multi-cultural cuisine.

I wish the participants a very fruitful and productive meeting and with that. Finally, we respectfully request the Rector of State University of Padang to open the ICOMSET 2015 officially.

Thank you,

Faculty of Mathematics and Science Prof. Dr. Lufri, M.S.

The International Conference on Mathematics, Science, Education and Technology

Message

from the

Chairman of Organizing Committee

Firstly, I would like to say welcome to Padang Indonesia. It is an honor for us to host this conference. We are very happy and proud because the participants of this conference come from many countries and many provinces in Indonesia.

Ladies and gentlemen, This conference facilitates researchers to present ideas and latest research findings that allows for discussion among fellow researchers. Events like this are very important for open collaborative research and create a wider network in conducting research.

In this conference, there are about 120 papers that will be discussed from various aspects of mathematics, science, technology, education and other related topics.

For all of us here, I would like to convey my sincere appreciation and gratitude for your participation in this conference.

Thank you very much

Drs. Hendra Syarifuddin, M.Si, Ph.D Chairman

DEVELOPMENT OF 2D VIBRATION DETECTOR USING FLUXGATE SENSOR BASED ON

PERSONAL COMPUTER

Yulkifli¹, Yohandri¹, Rahmat Triyono², Zulpadrianto³ ¹⁾ Staf Pengajar Jurusan Fisika FMIPA UNP ²⁾ Kepala BMKG Padang Panjang ³⁾ Mahasiswa Jurusan Fisika FMIPA UNP e-mail: yulkifliamir@gmail.com

ABSTRAK

The development of 2D vibration detector using fluxgate sensor based on personal computer has been done. This detector can be oprated for both vertical and horizontal axist. In previous work., the vibration detector has been develop for limited 1D. The detection system consist of hardware and software part. The hardware part, consist of fluxgate sensor circuit and interfaceing. Digiliization of analog fluxgate sensor output is done using ADC in microcontroller. The vibration data is processed using software develop with visual basic (C# language) and MPLAB IDE. The processed data is presented in personal computer display with 2D graph as fungtion of time

Keywords: 2D, Vibration detector, fluxgate, personal computer

1. INTRODUCTION

In line with the advancement of technology, the application of magnetic sensors in measurement and control engineering becomes increasingly growing. Its application can be found in navigation system, geophysical exploration, the earth's magnetic field mapping, position and distance determination of the object in high resolution [1]. In control and measurement, the slight magnetic field changes need high accuracy and sensitivity sensor [2]. There are a wide variety of magnetic sensors that have been developed for controlling and measuring such as hall effect sensors, magnetoresistif sensor, SQUID, and fluxgate sensors [3].

Fluxgate is a magnetic sensor that operate based on magnetic flux changes. The fluxgate sensor capable of detecting very small response up to nano tesla [4,5]. This sensor has a fairly wide range of measurement and detects the weak changes in magnetic flux. The measured magnetic flux is depends on the distance of the object. The characteristics of fluxgate sensor can measure the small distances [5], this ability made the sensor can be implemented as vibration detector. In the previous work, the mathematical models of vibration based on fluxgate sensor has been developed [6].

In this paper, the development of vibration detector based on fluxgate sensor will be presented. The detector can be operated in detection 2D vibration. The system consists of mechanical part, signal processing, microcontroller and personal computer for displaying data.

2. METHOD

In this work, experimental research laboratory is adopted as research model. In this experiment, data retrieval is done repeatedly, then analyzed, conclusions drawn, and reported the results. The characteristic of sensor is investigated as function of magnet position.

There are some equipment and component used in this study which are PC, downloader, analog and digital multimeter. The personal computer is used in programming the microcontrollers using MPLAB X IDE V1.70. The K510 downloader is used as microcontroller programmer [7,8]. Multimeter is used to measure the value of the components that will be used such as resistor and voltage in electronic circuits.

The electronic component utilize in this system consist of fluxgate sensor, resistor, capacitor, microcontroller as well as other supporting components. The supporting materials used are spring and magnets. Mechanical design of the system is combining from springs, body mass, mast poles, magnetic, fluxgate sensor as shown in Figure 1.

As shown in Figure 1, the mechanic system is built from vertical and horizontal sub system. The springs with constan k are used as vibration detector in both vertical and horizontal system. The spring oscillates at the point of equilibrium. A body of mass (M) is a load that serves as a buffer. For horizontal system, the magnet1 (m) is oscillating follow the movement of spring in horizontal direction. In other hand, the magnet2 (m) oscillating follow the movement of the spring and vertical directions. Sensor1 and sensor2 are flugate sensor installed in both vertical and horizontal system. This sensor will detects changes in magnetic position in vertical and horizontal direction for sensor2 and sensor1, respectively. The vibration is equivalent to the response given by the damping effect due to reduced friction and damping spring.



Figure 1. The design of the mechanical system

a. Modules of the system

The modules of the vibration detector system can be seen in Figure 2.



Figure 2. Modules of the system

Based on Figure 2, the out 1 represents the sensor output the result of motion detection magnet in vertical direction and out 2 is the sensor output the result of motion detection magnet horizontal direction. The connection to PC is done by using PIN USB1 and a LED is used as indicator when the system connected to PC. The electricity supply come in via PLN socket and controlled by ON/OFF button.

b. Block diagram of the system

Generally, the system consists of a power supply circuit, fluxgate sensors, signal conditioning circuits, microcontroller PIC 18F4550 and a PC. The data can be transferred to the PC using an interfacing software such as Visual C # programmer software and software MPLAB X IDE [8,9,10]. Block diagram of the system are shown in Figure 3.



Figure 3. Block diagram of the system

In Figure 3, the fluxgate sensor is utilized to detect the vibration of the magnet. Output of the fluxgate sensor are sent to the signal conditioning. The data obtained from the analog signal conditioning to be converted into digital data by the ADC. Microcontroller is programmed as signal processing and interfacing the selectronic system to a personal computer.

This research was carried out through several stages that are preparation and implementation stage. The preparation stage is the stage of preparing a research proposal, a preliminary survey to obtain the necessary data and documentation studies and literature related to the research problem. The second stage is implementation phase of research, this study begins by assembling the components in accordance with an instrument that has been designed and programmed the microcontroller.

The things to be considered in the implementation of this study are determination the performance and design specification. The investigation of performance specifications on system is done by identifying the functions in each constituent part of the system of measuring instruments by means of shooting every part of the system of measuring instruments as well as explain the functions of each section. On other hand, the determination of design specifications of the system is done by comparing the output of the system with standart measuring devices.

Data collection techniques in this research is conducted through measuring physical quantities contained in the system. The data is processed and interpreted using a PC. The measurement technique is performed both directly and indirectly. Data obtained directly is output voltage of fluxgate sensor that has been digitized and time, while the data obtained indirectly is amplitude, magnitude, accuracy and precision of the system.

3. RESULTS AND DISCUSSION

In this study, a vibration detector has been developed. The specification of the system is obtained in the form of performance and design. Vibration detectors are assembled using fluxgate sensor with a spring and a load. In case of vibration, the system will vibrate and trigger the fluxgate sensor. The assembled 2D vibration detector is shown in Figure 4.



Figure 4. The assembled 2D vibration detector

In case of vibration, the mechanical system is vibrating so fluxgate sensor will respond to the

ICOMSET

vibration. Mechanical system is covered by a box 29 x 18 x 35 cm in size. As shown in Figure 4, the system is consisted of calibrator in horizontal direction (1a) and calibrator in vertical direction (1b). The load is swing in horizontal arm (2a) and the vertical arm (2b). The 1 kg load (4a) and (4b) are installed on a spring (3a) for horizontal and (3b) for vertical direction. A magnet (5a) and (5b) is mounted in front of each fluxgate sensor (6a) and (6b) for horizontal and vertical direction, respectively.

The vibration will trigger the mechanic system to vibrate and the magnet changes the position relative to the fluxgate sensor. Variation of the magnet distance to the fluxgate sensor will produce the electric signal. This signal will be processed in a signal processing module as shown in Figure 5.

In Figure 5, a signal processing module installed in 21x16x8 cm box and consisted of pin connector fluxgate sensor (1), pin USB (2), On/ Off switch (3) and pin cable connector PLN (4). This module combines several electronic circuits for signals processing as shown in Figure 6.



Figure 5. The signal processing module



Figure 6. Electronic circuit for signals processing

Figure 6 is shown the signal processing module of the fluxgate sensor. The supply voltage is given by a power supply (1) that provides voltage for microcontroller and circuit board. Signal processing is done on circuit board (2) and microcontroller PIC18F4550 (3). The digital data as output of

microcontroller data is sent to the PC via USB serial bus.

Operating the device require a PC with the specification has been using a minimum net framework 4.0. The data presented in graphic software that has been created with Visual Basic programming language C# that called tool driver. This tool driver is used to display graphics, monitoring and data storage. The tool driver display is presented in Figure 7. As shown in the display, (1) is a title for the chart, (2) Represents the plotted graph of vibration data in horizontal direction and (3) in vertical direction. The noise filter is present on (4). The (5) is an auto scroll, (6) input the scale on the axis, (7) button set, (8a) and (8b) is count value for vertical and horizontal direction, respectively. The start and stop (on/off) data retrieval is on (9) and strip status of USB connection between the PC and system is shown on (10).



Figure 7. Tool driver display [11]

To integrate the system to a PC needed tool driver. Tool driver included with the data storage process that can be programmed to store data on a regular basis. The data is automatically saved when a USB connection is disconnected or program terminated. The data are stored in the application folder with the folder title "Log Data" and file name are stored according to the time of data storage. The file extension is set to .xls, therefore the file can be opened using Microsoft Excel application.

In integrating the vibration system to a PC needed a power supply circuit. The signal is processed and then forwarded to the microcontroller. The output voltage generated by the signal processing is converted into digital form by the ADC module contained in the microcontroller and the results will be stored in the memory address ADRESL and ADRESH. This program is developed using MPLAB X IDE. The flowchart of the program is presented in Figure 8.



Figure 8. Flowchart on PC program [11,12]

In the microcontroller, there is a USB module that programmed to be connected to a PC. This USB module will be configured as interface between the data stored in the microcontroller and PC. Measured data is presented on tool driver that developed using Visual Basic [12]. The detected vibration as function of vibration source distance for both vertical and horizontal direction are shown in Figure 9 and 10, respectively. There are four variation of the vibration source distance a, b, c and d with value 0.5m, 1m, 1.5m and 2m, respectively.



Figure 9. The vibration in vertical direction



Figure 10. The vibration in horizontal direction

The developed program (tool driver) has advantages. The application can be zoomed to the

running data and recorded data. The vibration data can be monitored in real time. Other advantages we are the recorded data format can be opened using general software, so that the stored data is more flexible to use. In operating this system, to operate optimally mechanical sensors need to be conditioned in order to be free from external magnetic fields such as magnetic materials and magnetic fields from power lines. In this 2D vibration detector, the system will generated vibration signal if vibrations that occur can actually vibrate the magnet so that the sensors can detect changes in the position of the magnet to the sensor.

4. CONCLUSION

The 2D vibration detector using fluxgate sensor with personal computer display has been developed. This sensor consist of mechanical system, fluxgate sensor, signal processing circuit and PC as display. The tool driver 12755 is used in sofware operating. Overall, the system can operate and generate vibration signal on the display. The direction of the vibration can be detected as well.

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