

Development of sound wave experimentation tools influenced by wind velocity

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Abstract. Development of important experimental tools in learning creative and innovative physics. The study aims to develop a sound wave experiment tool influenced by wind velocity. This tool is validated by comparing with standard measurements. The experimental apparatus is made of PVC tubes both ends of the open tube with a length of 137 cm. For the wind velocity obtained from a mini fan that is placed at one end of the tube open and regulated using a dimmer. It that enters the PVC tube is measured using an anemometer. The experiment kit is equipped with a pinch microphone to capture sounds and audacity software to display sound waves that enter the PVC tube. The experimental results obtained a sound velocity of 345.7 m/s with a wind velocity of 3.2 m/s. Sound velocity 347.5 m/s with wind velocity 5.0 m/s and sound velocity 348.9 m/s with sound velocity 6.4 m/s. Thus, the higher wind velocity value, the higher sound velocity. The contribution of this research is the innovation of physics laboratory media in the field of education.

Keywords: *sound wave, experimentation tools, wind velocity*

1. Introduction

The concepts in physics learning material can easily be understood by developing experimental-based learning media both conventional and virtual laboratories [1],[2]. Experimental activities make students able to directly observe an object being experimented on so that they can develop the skills they have. [3] Experimental methods also enhance understanding and strengthen students' knowledge [4]. In this experimental laboratory work, we need a tool or media as an object of visualization to explain a physical phenomenon that is difficult to see through direct observation such as sound waves [5].

The sound wave is included in the concept of abstract subject matter that is difficult for students to understand. Coupled with inadequate experimental tools make this sound wave learning material difficult to understand. So that innovation is needed to support the learning process so that it can run smoothly. Like the research conducted by Jaafar et al. by developing sound wave experimentation tools to visualize sound waves using smartphones on open and closed organ pipes, on both open and both closed pipes, and on the kundt pipe [6],[8].

Jose A Gomez [9] measured the wave propagation velocity using a microphone and speaker displayed on the smartphone and obtained the value of sound propagation fast in the air of (343 ± 3) m/s with a correlation coefficient of 0.998. Kadri et al. [10] research demonstrations of physics of sound waves using Visual Analyzer (VA) which is an alternative solution if there is no oscilloscope.



In this paper, the sound wave experiment tool was developed by considering the wind velocity obtained through the fan. So it is expected to be able to provide information about the velocity of sound propagation in the air.

2. Research method

The initial stage of developing experimental tools begins with sketching tools. The experimental instrument is designed to determine the velocity of sound in the air influenced by wind velocity. Tool sketch can be seen in figure 1.

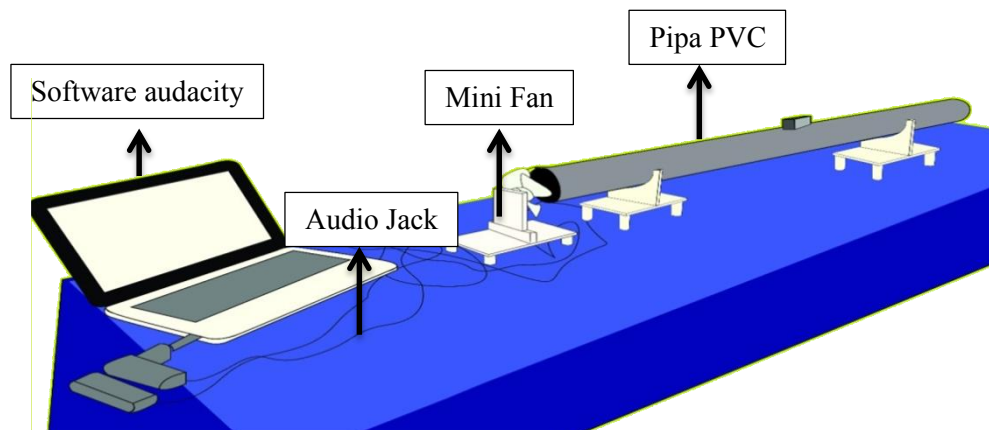


Figure 1. Sketch xof a sound wave experiment tool that is influenced by wind velocity

This tool is validated by comparing with standard measurements. The experiment was made of a PVC (Polyvinyl Chloride) tube with a length of 137 cm and both ends of the tube were open. The source of the wind velocity is used a mini fan that is placed at one end of the open tube, and the fan is equipped with a dimmer. Then the microphone is mounted on both ends of the open tube which has a function as a sound catcher that enters the PVC tube. The microphone is connected to the laptop via an audio jack. Wind velocity is measured using an anemometer. The display of sound waves entering the PVC tube is seen through the audacity software.

After the tools and materials are assembled, the fan is turned on by adjusting the velocity using a dimmer. Both slow, medium or high velocity. Then the two microphones are installed and placed on both ends of the open tube and connected to the laptop using the audio jack which is installed with the Audacity software.

The selected place is not too noisy when conducting experiments so that the resulting data is more accurate. When operating the tool, data retrieval is done 7 times to reduce the level of error in measurement.

3. Results and Discussion

Wind velocity is generated through a mini fan equipped with a dimmer and placed at one end of a PVC tube. The wind velocity enters the PVC tube together with the sound source captured by the pinch microphone mounted at both ends of the open tube and connected to the laptop via an audio jack.

Audacity software will display sound waveforms that are influenced by wind velocity. The audacity display can be viewed in figure 2.

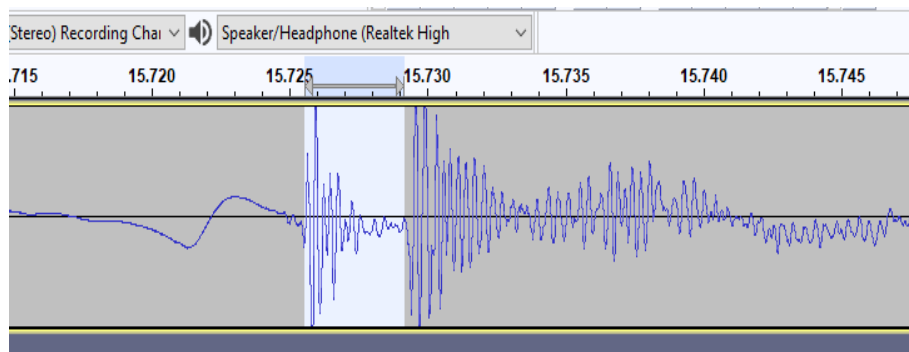


Figure 2. Display of sound wave audacity software that is influenced by wind velocity.

The sound wave velocity can be observed in the two open-end tubes which are influenced by wind velocity through the audacity software. In the audacity software, it can be seen the travel time of sound wave velocity which is influenced by wind velocity. The results of the measurement data of the experimental sound wave velocity which is influenced by wind velocity can be seen through figure 3.

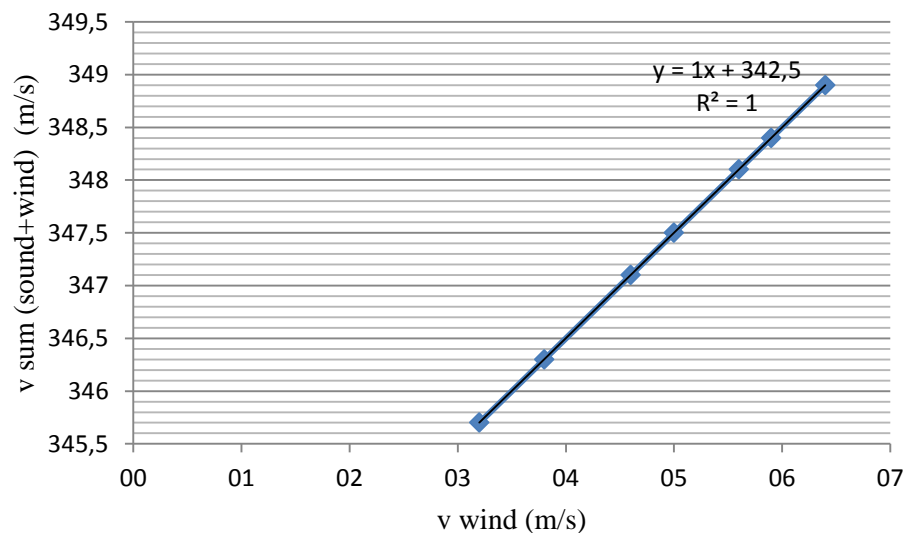


Figure 3. Graph of increase in sound velocity that is influenced by wind velocity.

Based on the graph, the velocity of sound is obtained which is influenced by wind velocity. When the wind velocity is 3.2 m/s, the sound velocity value is 345.7 m/s. When the wind velocity is 5.0 m/s, the sound velocity value is 347.5 m/s and when the wind velocity is 6.4 m/s, the sound velocity value is 348.9 m/s. the velocity of sound increases with increasing wind velocity in the direction of the sound source.

4. Conclusion

The increase in the value of the sound velocity is influenced by the high change in the value of the wind velocity. For the wind velocity in the air exceeds the normal velocity if the wind velocity is not ignored. For wind velocity large enough, the velocity of sound waves in the air will increase or decrease depending on the direction of the wind and the direction of the sound waves.

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