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SIMPLE MUSICAL INSTRUMENTS USING TOUCHLESS TECHNOLOGY FOR KIDS

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ABSTRACT

Musical instruments have been an important part of human culture since ancient times. In recent decades, technological developments have allowed us to create more sophisticated and creative musical instruments. one of them is by designing a simple musical instrument with arduino-based touchless technology. In recent years, touchless technology has become increasingly popular in product and application development. Touchless technology allows users to interact with devices in a contactless manner or in other words not touching the device itself. The purpose of making a simple musical instrument design with touchless technology based on Arduino is to design a musical instrument that can be used even without touching the musical instrument. and it is also hoped that users, in this case children, will be interested or like the musical instrument. In addition, by designing a simple musical instrument with arduino-based touchless technology, it can provide an innovative and hygienic music playing experience for children. meaning that the touchless technology used in the musical instrument can minimize physical touch or physical contact for children, and also minimize the risk of transmission of diseases or viruses in children. With the experimental method, namely realizing a simple musical instrument with touchless technology, measurements can be made of the performance of the musical instrument and the effectiveness of touchless technology which is the main factor in the purpose of this tool, which is expected that children can be interested in the world of music.

Keywords: Music, Touchless, Kids

1. INTRODUCTION

History of Musical Instrument

Musical instruments are an almost universal part of human culture. Archeology has discovered Paleolithic pipes and whistles Neolithic clay drums and mushroom horns. Ancient urban cultures in the Mediterranean Mesopotamia East Asia India and the Americas are well documented to have a variety of well-developed musical instruments suggesting that early development may

have existed much earlier. The source of the device. Some scholars speculate that the first instruments evolved from bow hunting with drums and other instruments. Others believe that musical instruments predate ships and bows. In areas considered integral to ritual... the development of various instruments in our world depends on the interaction of four elements. Transactional patterns and biases and the symbolic displacement of available physical technology. Therefore the Arctic inhabitants used stones with bone shells to make tools. Wooden bamboo sticks can be used in tropical countries. Societies that provide the necessary metals and technology can utilize these wastes in a number of ways. Mythology and symbolism play equally important roles. For example nomadic societies that depended economically and psychologically on specific animal species often made tools that resembled animals or chose tools made from bones embedded in rocks or trees. Material is available. Tools change oceans and continents to change and adapt.

So, music is an art form that has existed since prehistoric times and continues to evolve today. Playing a musical instrument is not only fun, but it can also help children's cognitive and emotional development. However, not all children have the same interest in music, especially when it comes to playing musical instruments. In this era of advanced technology, the use of technology in building musical instruments can be an attractive alternative for children who are less interested in conventional musical instruments. One of the technologies that can be used is touchless technology that can make it easier for children to play musical instruments. In this paper, we will discuss the design of a simple musical instrument with Arduino-based touchless technology to increase children's interest in music. This musical instrument is designed to be easily understood and played by children, so that it can trigger their interest in learning music. In its development, this touchless musical instrument uses the Arduino platform as the main base. Arduino is an open-source platform that is easy to use and has a lot of community support. In addition, the touchless device used is also affordable and easy to obtain. It is hoped that with this simple musical instrument, children will be more interested in learning music and developing their creativity. In addition, the use of innovative touchless technology can be an interesting alternative in introducing children to the world of music.

2. RESEARCH METHOD

This research is in the form of designing a simple musical instrument with Arduino-based touchless technology for children.

1. Music instrument design: the instrument design can be xylophone or piano

Figure 1. Xylophone

2. Touchless technology design: touchless design requires supporting components such as infrared sesnsors, LED, Arduino, Speaker

Figure 2. Type of touchless technology, Air Piano

2.1 What is Touchless Technology?

Touchless technology involves any device that can be used or operated without the need for physical touch. Although the primary benefit of touchless technology is improved health, its appeal is not limited to hygiene and safety. It can also improve customer engagement and streamline processes, to name a few.

Reduced costs**:** Businesses can use simple, manual strategies, such as sanitary levers, to protect employees from contaminated surfaces. Any costs accrued from implementing touchless technology are balanced by the reduced risk of health-related costs and fines.

Aesthetic appeal**:** Touchless technology devices come in a range of stylish and discreet designs that can enhance the visual appeal of a space.

Enhanced customer experience**:** Touchless technology can work to enable or enhance a streamlined, self-directed, and more satisfying customer experience one with convenience at its core.

2.2. What is Arduino?

Arduino is an open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its hardware products are licensed under a CC BY-SA license, while the software is licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially from the official website or through authorized distributors.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (for prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs. The microcontrollers can be programmed using the C and C++ programming languages, using a standard API which is also known as the Arduino Programming Language, inspired by the Processing language and used with a modified version of the Processing IDE. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) and a command line tool developed in Go.

The Arduino project began in 2005 as a tool for students at the Interaction Design Institute Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

The name *Arduino* comes from a bar in Ivrea, Italy, where some of the project's founders used to meet. The bar was named after Arduin of Ivrea, who was the margrave of the March of Ivrea and King of Italy from 1002 to 1014.

Figure 3. Arduino Uno

2.3. How Arduino-based touchless technology works

Arduino-based touchless technology works by using sensors to detect hand movements and gestures. These sensors can detect the distance between the hand and the sensor, as well as the direction and speed of the movement. The data collected by the sensors is then processed by the Arduino microcontroller, which translates it into musical notes or sounds. There are various types of sensors that can be used in touchless musical instruments, including ultrasonic sensors, infrared sensors, and capacitive sensors. Each type of sensor has its advantages and disadvantages, and the choice of sensor depends on the specific application and the desired level of accuracy and sensitivity.

2.4. How do touchless musical instrument works

Touchless musical instruments work by using sensors to detect hand movements and gestures, which are then translated into sound. One example of a touchless musical instrument is the theremin, which is an electronic musical instrument controlled without physical contact by the performer. The performer's hand acts as the grounded plate of a variable capacitor in an L-C circuit, which is part of the oscillator and determines its frequency. The distance between the performer's hand and the pitch control antenna determines the pitch of the sound produced. Small hand movements can be used to produce vibrato effects, while larger movements can create swooping sounds or glissandos. Other touchless musical instruments can be designed using sensors such as motion sensors, infrared sensors, or ultrasonic sensors, which can detect hand movements and gestures and translate them into sound.

3. RESULTS AND DISCUSSIONS

3.1. Results

3.1.1. Block Diagram

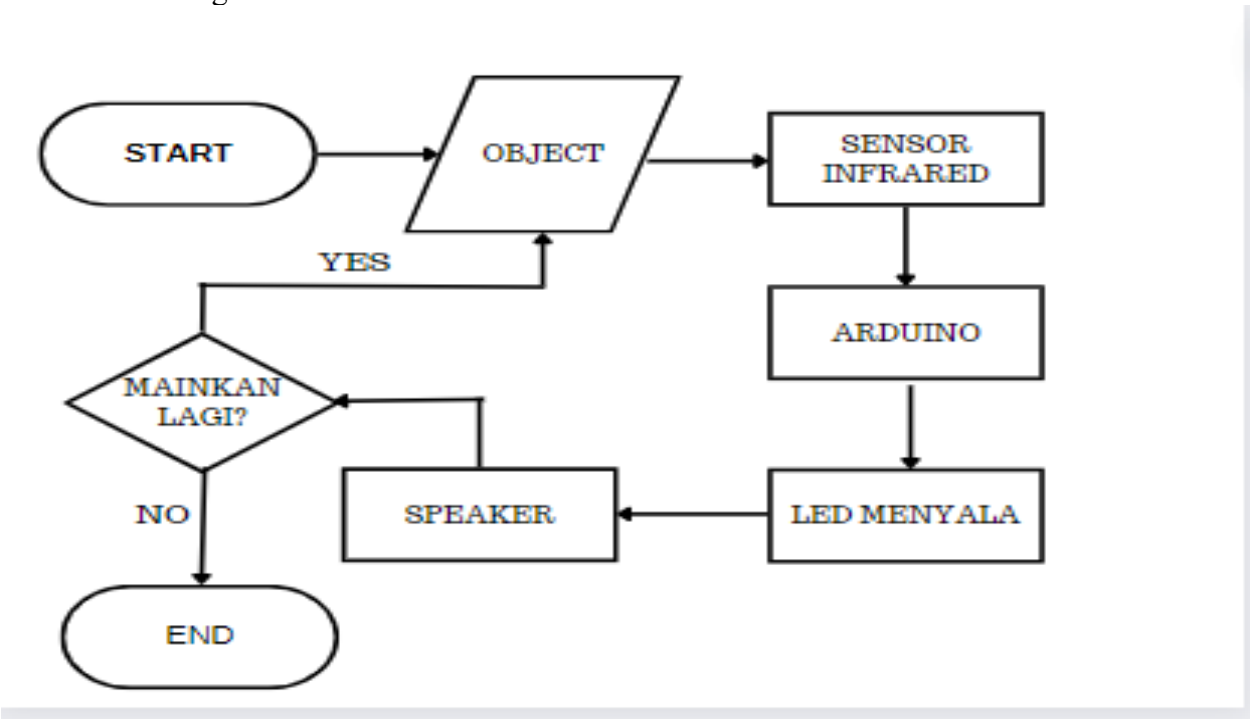

Figure 4. Block diagram for the music instrument

This musical instrument design will use a contactless touch sensor to read data and send it to the Arduino. This sensor will read data in the form of hand movements of children who play this musical instrument. Then the data will be sent to the Arduino, which will process the data according to the program that has been instructed. Then the program will make the LED light up according to the tone the child is playing. Before finally forwarded to the speaker and produce output in the form of sound. The child will be given the option to play another tone or not. If the child wants to play another note then the child will move his hand towards the other sensor. Otherwise, the music game is finished.

3.1.2. Experiment

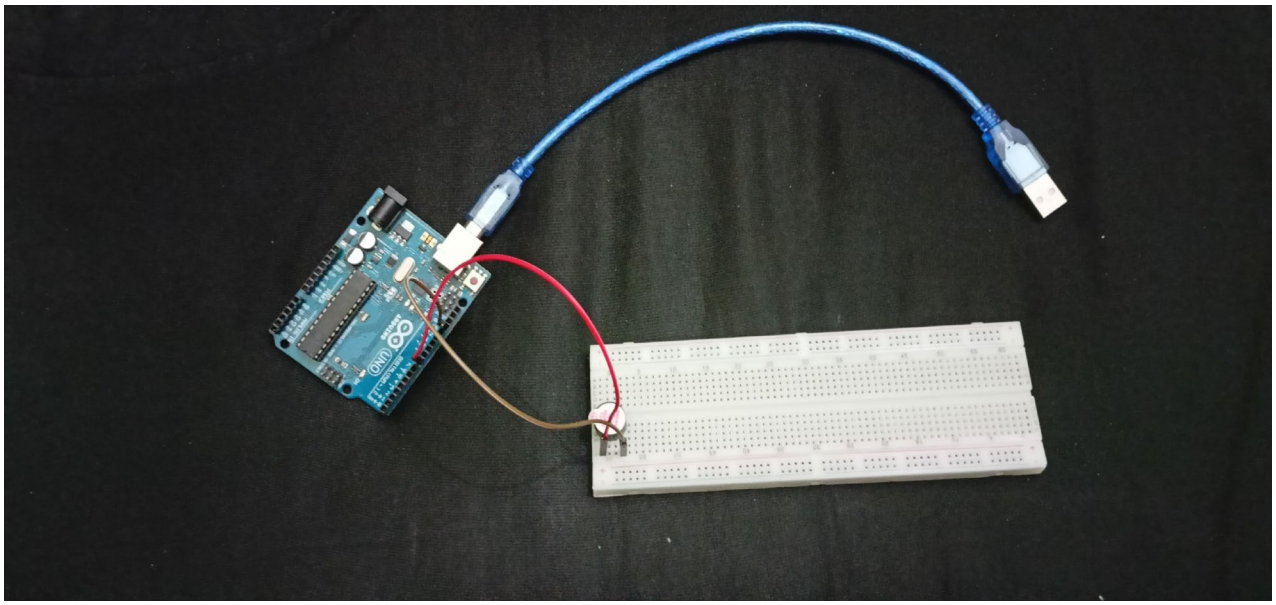

Figure 5. A series of experiments to play the note do

Here we did a small experiment first. that is trying to play the tone do using arduino and buzzer output. the circuit made consists of arduino uno R3, buzzer, jumper cable, and board.
first we assemble the circuit as shown in the picture. the buzzer is placed first, placed anywhere you can. then pay attention to the legs of the buzzer. the longer leg is the positive leg and the shorter one is the negative leg. then connect the positive leg of the buzzer to pin 8 on the arduino using a jumper cable. after that, also connect with a jumper cable between the negative leg and ground (GND) on the arduino. then the arduino is attached to the computer to start programming.
an example program to play the tone do is as follows

```
int buzzerPin = 8; // Pin output buzzer
int melody[] = {  // Melodi nada do
  261,  // C4
  0,    // Pause
};

void setup() {
pinMode(buzzerPin, OUTPUT);
}
void loop() {
 for (int i = 0; i < 2; i++) {
 if (melody[i] != 0) {
 tone(buzzerPin, melody[i], 500);  // The
duration of each tone is 500 ms
 }
 else {
 delay(500);  // The pause between each
note is 500 ms
  }
 }
```

Figure 6. The code program for experiment to play note do

This program code uses the buzzer output pin on pin 8 and the melody sounded is a do tone. Each note is paused for 500 milliseconds and between each note is also paused for 500 milliseconds. We can change the values of the buzzerPin and melody variables according to our needs. after the program is complete, upload the program that has been written into the arduino. after that from the buzzer there will be a sound like do in the musical scale. the experiment continues until the do tone is high.

Specification of this tool:

1. Infrared sensor
2. LED
3. Arduino
4. Modul Speaker

Infrared

An infrared (IR) sensor is an electronic device that detects and measures infrared radiation in its surrounding environment. Infrared radiation, also known as infrared light, is a type of electromagnetic radiation that has longer wavelengths than visible light and is invisible to the human eye. All objects in the universe emit some level of IR radiation, but two of the most obvious sources are the sun and fire.There are two types of IR sensors: active and passive.

Active IR sensors emit and detect infrared radiation using a light emitting diode (LED) and a receiver. They work with radar technology and can detect not only movement but also how far

an object is. Passive IR sensors detect infrared radiation emitted by objects in their field of view.They do not emit any radiation themselves

LED

LED stands for Light Emitting Diode. It is a semiconductor device that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light is determined by the energy of the photons. LEDs are used in bulbs and fixtures for general lighting applications. They are small in size and provide unique design opportunities. LEDs are highly energy-efficient and have the potential to fundamentally change the future of lighting in the United States. Residential LEDs use at least 75% less energy and last up to 25 times longer than incandescent lighting

Arduino

Arduino is an open-source electronics platform that consists of both hardware and software. It is designed to be easy to use and is popular among hobbyists, tinkerers, and makers for building electronic projects.

The hardware component of Arduino is a physical programmable circuit board, often referred to as a microcontroller. The board is equipped with input/output pins that can be used to read inputs, such as light or temperature, and control outputs, such as LEDs or motors. The software component of Arduino is an Integrated Development Environment (IDE) that allows users to write, compile, and upload code to the board.

Speaker

A module speaker is a type of speaker that is designed to be modular, meaning it can be easily connected or disconnected from other components. There are different types of module speakers, including those that are built into a platform with multiple speakers oriented in different directions to create a surround sound effect, and those that are designed to be mounted on a wall or box. Some module speakers are also designed to handle high wattage speakers and provide high fidelity sound.

Figure 7. specification components of the music instrument

Benefits of Musical instrument using touchless technology

There are several potential benefits of touchless musical instruments. One benefit is that they can be played without physical contact, which can be useful for people with physical disabilities or limitations. Additionally, touchless musical instruments can provide a unique and innovative way to create music, which can be appealing to musicians and music enthusiasts. Touchless musical instruments can also promote sensory development, movement, balance, hearing, and touch in toddlers and young children who are learning to play different instruments. Furthermore, touchless musical instruments can be designed to be more accessible and inclusive, allowing more people to participate in music-making and performance. Overall, touchless musical instruments have the potential to provide new opportunities for music-making and performance, while also promoting physical and sensory development in children

3.2. Discussions

Music instruments that utilize touchless technology can be an exciting and engaging way for kids to learn and play music. These instruments typically use sensors or motion-capture technology to detect the movements of the user, allowing them to create sounds and music without the need for physical contact.

One example of a touchless instrument for kids is the Theremin, which has been around for nearly a century. The Theremin uses two antennas that detect the position of the player's hands in space, allowing them to control pitch and volume.

Another example is the Skoog, a cube-shaped instrument that can be squeezed, twisted, or tapped to produce different sounds. The Skoog uses touch sensors to detect the user's movements, allowing them to play a variety of instruments and sounds.

There are also touchless drum kits available, such as the Aerodrums, which use motion-capture technology to track the user's movements and create the sounds of a drum kit. This can be a great way for kids to learn rhythm and timing without the need for physical drums.
Touchless instruments can be especially beneficial for children with physical disabilities or limitations that may make it difficult to play traditional instruments. By using touchless technology, these children can still experience the joy and benefits of making music.
Overall, touchless music instruments can be a fun and innovative way for kids to explore music and develop their musical skills. As technology continues to advance, we can expect to see even more exciting touchless music instruments designed specifically for children.

4. CONCLUSIONS AND SUGGESTIONS

In conclusion, a simple musical instrument with Arduino-based touchless technology is an excellent tool for introducing children to the world of music. This technology makes learning music more accessible and enjoyable for children and helps them to develop their motor skills, hand-eye coordination, concentration, and focus. With numerous examples of touchless musical instruments available, the possibilities for creating unique and engaging musical experiences for children are endless.

Whether you are a parent, teacher, or music enthusiast, incorporating touchless musical instruments into your child's learning experience can provide them with a fun and exciting way to explore the world of music.

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REFERENCES

Journals:

1. Huang, Y., & Huang, C.-M. “Design and Implementation of an Interactive Music Learning System Based on Arduino and Gesture Recognition Technology, Journal of Educational Technology Development and Exchange (JETDE), 10(1), 1-14, 2017.

2. Jhaveri, R., & Shah, S, “Touchless Air Drums Using Leap Motion Controller and Arduino Uno Board for Music Education”, International Journal of Computer Applications, 146(11), 25-29, 2016.

3. Abdul Rafli, "Arduino-based Touchless Charity Box Design", 2021.
4. Ayuningtyas, Senja, "Learning Media for Traditional Musical Instruments using Android" in Cultural Arts Subjects at SMP Negeri 4 Tulungagung, Thesis, Semarang State University, 2019.

5. Adina Sastra Sembiring, "Music Knowledge in Early Childhood Education", Medan State University, Medan, 2017.