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A novel smart handpiece controlled by voice command system

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Abstract

Objective: To investigate the possibility of smart handpiece for controlling dental rotational instruments using the voice command system.

Material and Methods: This smart handpiece has a battery that can be used directly using AC 220V power supply. On the handpiece, a sound sensor that can recognize sound is provided. This sound sensor can receive commands to adjust the rotation speed of the handpiece, adjust the water and wind are released by the handpiece. In order for the tool to work properly we use a microcontroller to be able to carry out its functions when the sound sensor receives signals. Next the microcontroller will execute the programmed commands such as the voice command that can turn on the compressor to adjust the motor rotation and water output on the handpiece.

Results: According to our study, the smart handpiece can work well with the voice command system.

Conclusion: A novel smart handpieces provides promising prospects for use in dental practice.

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Keywords: Handpiece, Micro controller, Voice command, Voice recognition

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Introduction

Caries is a disease that results in demineralization, cavitation and destruction of the hard tissues of the teeth by microbial activity that converts leftover food glucose into acids which can damage tooth tissue. Basic Health Research Results (Riskesdas, 2013) state that caries experience will increase with age. Shows that the Decayed, Missing, and Filled Teeth (DMFT) index in the 12 to 14 years age group is 1.4 while in children aged 15 to 24 years it is 1.8 and continues to increase with increasing age. The Health Research and Development Agency of the Ministry of Health of the Republic of Indonesia (2013) said the prevalence of dental caries in Indonesia was 53.2%. According to the World Health Organization (WHO) in 2012, 90% of school children worldwide have had dental caries.[1] Handling of dental caries generally uses a rotary instrument one of which is a handpiece. The handpiece is a sophisticated combination of parts that are perfectly synchronized at high speeds. This combination provides easy and strong cutting ability so the clinician can efficiently remove the tooth structure without disturbing the comfort of the patient. The handpiece is divided into two types, handpiece high speed and low speed. Both of these tools have different drive components and different functions. It is difficult for clinicians to use because it must replace the first of handpiece the high-speed to handpiece low speed.[2] One component handpiece consisting of head, neck and body can cause noise coming from airtubine which is in the part head of the handpiece and compressor.[3] This tool is often considered by the community as a frightening tool that causes anxiety in pediatric patients. Fear and anxiety usually originate from the noise generated from the handpiece or compressor so that it can cause patients to refuse dental treatment. Anxiety is also related to experiences that patients have experienced in previous treatments, so patients are anxious if the next treatment will be more painful.[4] Most children have fear and anxiety about dental care, so that it becomes an obstacle for dentists in trying to improve the dental health of the community, especially children, because the patient's anxiety has a negative effect on the treatment procedures to be performed. Fear and anxiety are the causes of 15% failure of dental care.

In addition to causing anxiety in children through sound, the use of a handpiece also causes many errors in treatment. In dental care, errors can occur due to accidental operators that are often referred to as iatrogenic. Iatrogenic injury is a broad term that can be defined as 'damage, injury, damage or

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interference resulting from doctors' activities. Iatrogenic injuries resulting from accidental or wrong treatment, or may be the result of treatment by a therapist. Iatrogenic dental care can cause injury to either a tooth or periodontium or both. Some examples of reports of cases of iatrogenic teeth have been published in the literature. Also, many produce periodontal defects. Retained black stitches, rubber dam caught, contact stomatitis for resins polymerize themselves when used directly in the oral cavity, and root perforations that occur frequently during preparation.[6] During dental and periodontal treatment, various instruments, namely rotary instruments or vibrating hand, electrosurgical units, and lasers come into contact with the oral cavity, and improper use or this application can result in trauma to the gingivallesion.[7] When a doctor or other health worker tries to cure or alleviate or treat a patient's health problems, it will produce psychological and functional disorders, diseases and other disorders so this is what is meant by iatrogenic. Procedural errors can be avoided by a doctor by relying on his knowledge, intuition, and patience during treatment.[8]

Handling of iatrogenic anxiety and errors is one of the efforts to improve dental and oral health in the community, especially in areas with low levels of health. In improving the health of people in remote areas it is important that there is equal distribution of human resources and equipment. However, the availability of tools is still limited, especially the handpiece which is still very minimal for remote areas due to expensive, heavy equipment and difficult to reach geographical conditions. The challenges in implementing UHC in Asia varied greatly and the side was not ready supply, which included the availability of infrastructure, equipment, essential drugs, and human resources (HR). In addition, the competence of HR itself is still an obstacle.[9,10]

Based on the background above, the compiler made a new innovation on the rotating dentistry instrument that could reduce the above problems by making smart handpiece: Control of dentistry play instruments using the voice command system. Handpiece with a low noise level and devices portable so that it is cheaper and more efficient and can overcome the above problems. Smart handpiece also presents a new innovation in the form of combining two handpieces namely high and low speed in one device so that it no longer makes it difficult for dentists to use them.

The purpose of making this tool: know the design of the smart handpiece control of rotating dental instruments using the voice command system; knowing the working mechanism of the smart handpiece control of rotating dental instruments using the voice command system; knowing the working mechanism of the smart handpiece control of rotating dental instruments using the voice command system; knowing the advantages of the smart handpiece control of rotational dentistry instruments using the voice command system.

Material and Methods

The making and testing of tools was carried out in the Gowa Engineering Faculty Control and Instrumentation Laboratory (LSKI) and carried out for 5 months. Tools and materials needed to realize this idea are Microcontroller Atmega-2560 from Microchip (US), Sound Sensor voice Recognition v3.0 from Elechouse (shen zhen,China), Air Pressure Sensor from NXP (Hong kong), Mini Air Compressor from Wipro tools (Indonesia), Handpiece (check your handpiece brand), Selenoid valve from Airtac (Japan) and raw materials from local products.

Smart handpiece Specifications: Pressure before regulated: 3-6 bar; Regulation pressure: 1.5-3 bar.

Pressure rise time (towards 3 bar): 120s; Device noise: 70dbm; 3-Levels of voice speed control: Low speed (1.5 bar) speed - 7000rpm; Medium speed (2.2 bar) speed - 20000rpm; High speed (3 bar) speed - 30000rpm; 5 liter air storage tank; Can handle 1 handpiece (4 hole type); Working under temperature 150 degrees; Voice command matching time delay: 100ms; Working voltage 210-230v/50Hz; The length of the voice mic cable is 1m, and the length of the handpiece hose is 1.5m; Seven seveable voice commands; Minimum level (volume) of recorded sound is 60dbm; Over pressure protection (>6 bar) and over temperature (>150 degrees); Dimension length 300mm, width 400mm, height 250mm.

We design the tool smart handpiece with great attention to the security, benefits and efficiency of the tools that we will design. The design that we made is intended so that the tool smart handpiece can be carried everywhere and easy to use.

This tool smart has a battery that can be recharged or can directly use AC 220 V mains voltage. On the handpiece is given a sound sensor that can recognize the sound. This sound sensor can receive commands to adjust the rotation speed of the handpiece, adjust the water and wind to be released by the handpiece.

The compressor is used to increase the wind pressure which will be channeled to the handpiece to deliver water out to the nozzle on the handpiece.

In order for the tool to work properly we use a microcontroller to be able to carry out its functions when the sound sensor signals. The microcontroller will then execute the programmed commands such as a voice command that can turn on the compressor

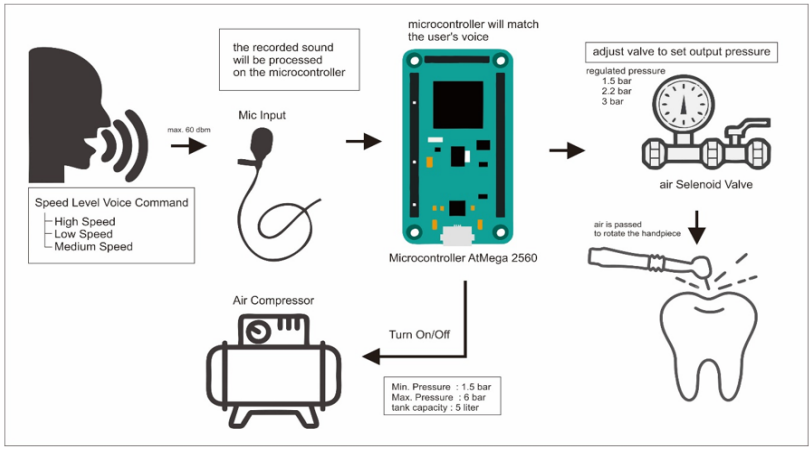

Figure 1 **This function test is carried out to determine the success rate of smart handpiece in working**

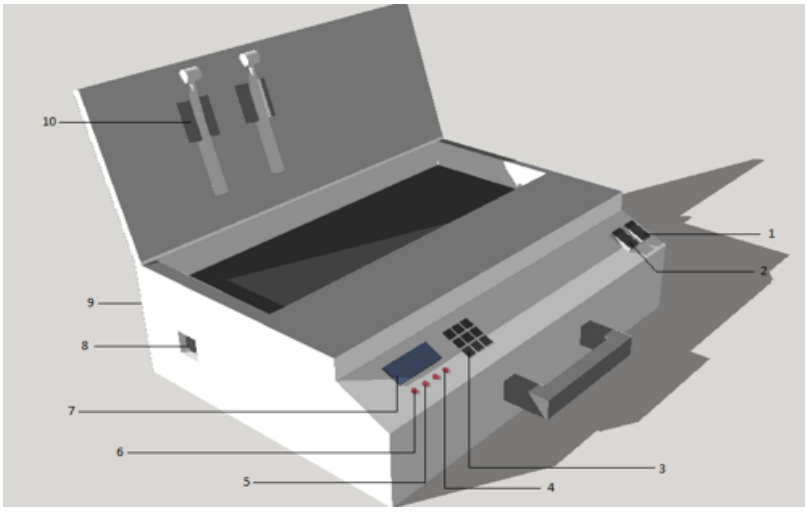

Figure 2 **Smart handpiece design**

compressor to regulate the motor rotation and output of the water on the handpiece.

In the instrumentation stage, all components and materials are arranged like a design that was originally designed. For a battery power supply, it is connected to a step-DC circuit down to get the desired regulated voltage. Whereas for a 220 VAC power supply connected to a DC converter circuit so that the DC voltage is obtained, then connected to all loads. The control circuit uses a 5 VDC power supply that is used to operate control circuits such as sound sensors, temperature sensors and pressure sensors to receive input. While compressors, motor drivers, solenoid valves and displays as actuators. The design of the body of the tool uses aluminum as the main supporting bone so that it can protect all the components in it firmly. On the outside is wrapped in acrylic fiber so that the design is more study. The handpiece is designed using the main filament material that is printed according to the design made. Uses a high-speed DC motor connected to a driver DC motor to adjust the rotating speed of the motor. Installation of nozzle on the handpiece as a place for discharge of water and wind that has been channeled from the compressor and water pump. Installation of sound sensors, the output is connected directly to the microcontroller so that voice data can be directly processed and the microcontroller can directly make decisions from the sound given.

Results

To make this tool easy and safe to use, the working mechanism of the tool is made as well as possible and a good safety system so that its use does not injure the user and does not cause damage to the tool. The microcontroller becomes the main brain or a place in the processing of commands from input and data processing and actuator control. The sound sensor is the main sensor in this tool whose output is connected directly to the microcontroller so that it can provide a direct input signal when it recognizes sound. When the voice command turns on the handpiece it reads the microcontroller activates a relay which will cause the handpiece to operate. When a voice command to change the rotational speed of the handpiece motor is entered, the microcontroller will adjust the Pulse-width modulation (PWM) value in the motor driver which will cause the motor speed to increase or decrease. Likewise, in controlling the compressor valve, turn on and the water pump. The sound sensor as the main controller that can regulate all processes in the operation of the handpiece makes it very easy to use so that users no longer need to use many switches to turn on or turn off all actuators in this tool.

The tool testing phase is carried out in order to see the performance of the tool as expected. At the testing stage, several things that need to be considered include; the effectiveness of the sound sensor how well it receives commands from users, and sees the performance of actuators such as (compressors, water pumps, and motors). The most important thing is to supervise the entire circuit so that there is no short circuit that can burn the components and injure the user.

Discussion

The main components of this smart handpiece are a handpiece and voice recognition module. The type of handpiece used is a high-speed wind turbine

handpiece that requires air flow to rotate. Then a compressor is needed in the design process as a producer of certain pressure winds and other complementary components that make up the smart handpiece.

Some supporting components such as; wind filter that serves to filter the wind produced by the compressor. A microcontroller and LCD as a voice command data processing unit and interface display on the smart handpiece and also a power supply unit designed with good security so as not to experience problems such as short circuit, over discharge, over current, and over heat. For power supply parts we design a power supply unit from a home power source so that getting the power supply from this smart handpiece can be easier. There is also a battery used in this smart handpiece as a replacement power supply when there is no 220 VAC power supply. This battery can last up to 3 hours of work and to automatically recharge when the Smart Handpiece gets a 220 VAC power supply. The power used is 130 watts when operating.[9] In designing this power supply unit, its very supportive that the handpiece can be carried everywhere easily and is very efficient in power usage and guaranteed system reliability.

To make this tool easy and safe in its use, the working mechanism of the tool is made as good as possible and a good safety system so that its use does not hurt the user and does not cause damage to the device. The microcontroller becomes the main brain or the place to process commands from the input and data processing and control of the actuator. The sound sensor as the main sensor on this device is output directly connected to the microcontroller in order to provide direct input signals when recognizing sound. When the voice command turns on the handpiece is read then the microcontroller activates the relay which will cause the handpiece to operate. When the voice command to change the rotating speed of the handpiece motor is inserted, the microcontroller will adjust the PWM value in the motor driver which will cause the motor speed to increase or decrease. Likewise, in controlling the turning on the compressor valve turns on and the water pump. The sound sensor as the main controller that can manage all processes in the workpiece makes it very easy to use so that users no longer need to use many switches to turn on or turn off all actuators on this device.

Testing phase is intended to see the performance of the tool as expected. At the testing stage several things that need to be considered include; The effectiveness of the sound sensor how well it receives commands from its users and looks at the performance of actuators such as (compressor, water pump and motorbike). The most important thing is to keep an eye on the entire circuit so that there is no short circuit that can cause burning of components and injuring users

Conclusion

Smart handpiece is a tool that can be used with a sound control system that has an efficient and portable design so as to facilitate the operator in its application.

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Conflict of Interest

The authors report no conflict of interest.

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