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Digital Position Analyzer

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Abstract

Conventional method of transferring the tripod mark is an arbitrary method, and to eliminate this arbitrariness and to get the accurate reading a new technique is introduced. In this technique we are describing a Digital position analyzer which helps in measuring the tilt of a surveying table and this measurement can be recorded which makes it easy to reproduce data.

Keywords: Arbitrary Method, Bridge Parallelometer, Graphite Rod, Tripodization

Introduction

Removable partial denture is considered as a treatment of choice for partially edentulous patients when fixed dental prosthesis or implant supported prosthesis are contraindicated. Accurate analysis of the diagnostic cast is one of the fundamental and mandatory steps in the designing of a Removable partial denture. This is mainly done with the help of a surveyor.

The Surveyor is a paralleling instrument used in the construction of a dental prosthesis to locate and delineate the contours and relative positions of abutment teeth and associated structures. [GPT -9]. The main objective of surveying the diagnostic cast is to determine the most desirable/acceptable path of placement that will eliminate or minimize the interference to placement and removal of prosthesis. This involves identifying the height of contours, guiding planes and interferences.

The path of insertion should be determined on the diagnostic cast and then transferred to a definitive/ master cast. The method of recording and reproducing the selected tilt of the cast is termed Tripoding or Tripodization. The most commonly adopted method is to

place three widely separated points on the cast in the same horizontal plane. These marking on the diagnostic cast are then transferred to the master cast by arbitrarily marking these points in the master cast.

Mankind is going through yet another phase of transition, where almost all human endeavors are being amalgamated to technology. Even our thought process is getting digitalized in this postmodern era. In this process, each and every data is being converted into a digital format. Adopting digital technologies, contribute to making our work easier and precise.

As mentioned earlier, conventional method of transferring the tripod mark is an arbitrary method, and to eliminate this arbitrariness and to get the accurate reading a new technique is introduced. In this article, we are describing a Digital position analyzer which helps in measuring the tilt of a surveying table and this measurement can be recorded which makes it easy to reproduce the data.

History of surveyors[1]

- Dr. Herman E. S. Chayes, an early pioneer in both fixed and removable prosthodontics, wrote extensively about precision attachments. Around 1920, Dr. Chayes developed the Parallelometer.
- Dr. A. J. Fortunati was the first to demonstrate the advantages of using a mechanical device to map the contours of the abutment teeth.
- Dr. A. J. Fortunati marked survey lines by replacing the steel rod by graphite rod.
- Dr Kennedy coined the term “Height of contour
- J. R. Schwartz credited Weinstein for pioneering “case and clasp surveying”
- Stanton-Hanau Dental Surveying apparatus, patented in 1917
- O. C. Applegate credited Fortunati with “pointing out” in 1918 that a mechanical device could be used to chart correct clasp outlines and for suggesting that a “bridge parallelometer” could be used for this purpose.
- The original Ney surveyor was introduced in 1923. It featured a convenient palm rest on the top of the vertical arm. Designed by Weinstein and Roth, it was the first surveyor to be commercially available to the profession2.

11 dental surveyors had been featured in scientific exhibits at the American Dental Association’s 1948. Annual Meeting. These were:

- Ney—1923
- Brown-Maier—1925
- Wills—1929
- Lentz—circa 1935
- Lineer—1937
- Ney—1937 (Fig 4*B*)
- Franzwa—1937
- Ringle-Hiatt-Smith—1944
- McKay—1944
- Hagman—1944
- Roach—1944

The Basic Dental Surveyor[1]

Although they may vary significantly in design, all basic dental surveyors have certain features in common.

These include:

1. A level platform, parallel to the bench top.
2. A cast holder, which supports the cast to be analyzed and is free to move across the platform. It includes a clamp to hold the cast firmly in place and a ball-and-socket joint between the table and base.
3. A vertical arm that supports the suprastructure of the surveyor.
4. A horizontal arm that usually is parallel to the horizontal platform, and perpendicular to the vertical and surveying arms, which it connects.

5. A surveying arm that drops vertically from the horizontal arm and that is capable of vertical movement. Its lower end has a mandrel capable of holding surveying tools.
6. Interchangeable surveying tools including an analysing rod, carbon marker, undercut gauges, and blockout tools

Principal uses of dental surveyor [1]

1. To determine the most desirable paths of insertion and removal for removable partial dentures.
2. To identify proximal surfaces that must be prepared to serve as guiding planes.
3. To delineate the heights of contour for all of the teeth and to locate and measure retentive areas.
4. To locate both dental and osseous contours that could interfere with insertion and removal of a partial denture framework and to allow accurate charting of the necessary mouth preparation.
5. To record the cast position and its relation to the path of placement.

Various methods of Tripoding

In scoring method, three vertical marks are made along the base of the cast on the posterior and lateral sides for repositioning of the cast. The analyzing rod of the surveyor is aligned with all three marks. These conventional methods are easy and do not need additional means. These methods only allow repositioning of the cast on marks, which have been placed; however, accurate repositioning of this cast or the other casts such as definitive or duplicated casts on the surveyor may be sometimes difficult. [2]

Several devices have been suggested for recording and reproducing the cast orientation. A geometric technique was introduced for recording the cast orientation, which requires a mounted protractor on the surveyor. [3]

Similar method was described in which a pin is attached vertically to the cast as a mean for repositioning the casts on a surveyor. [4]

In addition, a device was developed with three adjustable arms engage to a surveyor, which contact the casts at three divergent points. [5]

Using the indices of the teeth occlusal surfaces and ridge area with different devices and materials were also recommended to record the path of insertion. [6-8]

A tripoder attachment with adjustable arms with three graduated (mm) pointers has been introduced, which can be locked at any height and selected points. [9]

Dumbrigue and Chingbingyong used an inclinometer for repositioning the cast on a surveyor table, which allows tilt to be measured in 1° increments in the frontal and sagittal planes with direct visualization of tilt measurements in two plans. [10]

The tilt of the cast is registered with an acrylic occlusal index that can be used to reorient the tilt of multiple casts such as study and definitive casts. [11]

An innovative approach was introduced using an easily accessible mobile phone (clinometer app) to record and reorient the cast in an easy way. [12]

This article describes a digital position analyzer for measuring the angle of the tilt for recording the orientation of the cast and for reproducing this tilt on the master cast

Components of digital position analyzer

1) LCD display (Figure 1)
2) Arduino Microcontroller (Figure 2)

Arduino Microcontroller gets inputs from the sensor (attached to the surveying table) which will be in radians and the Arduino is used to convert this into angle. This calculated value is displayed using display screen.

3) MPU 6050 (Gyroscope & Accelerometer) Sensor for Angle and force Measurement

Figure 1: LCD display

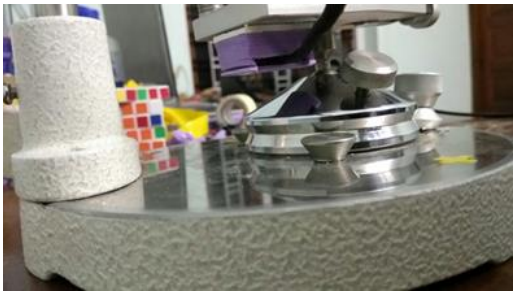


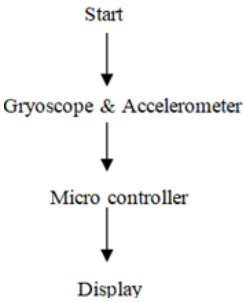
Figure 2: Arduino microcontroller attached to the surveying table

Arduino microcontroller gets inputs from the sensor (which is attached to the surveying table) which will be in radians and the arduino is used to convert this into angle. This calculated value is displayed using a display screen.

The microcontroller has the program written into it

1) For measuring data from sensor
2) Converting it into Angle (Degree)
3) Displaying data

Gyroscope is used to measure the angle but if used alone, it tends to drift away and show different angles. So to compensate that drift accelerometer is combined with gyroscope to make it stable.



Using the device

The sensor is attached to surveying table. It senses the movement of the surveying table and transferred it to the microcontroller. Microcontroller converts this data into an angle and it is displayed on the screen.

Tilt display (Figure 3)

The tilt is displayed along 3 axis, X axis, Y axis and Z axis. X axis denotes the antero-posterior tilt (pitch)(Figure 4) and Y axis denotes the lateral tilt(roll))(Figure 5). Rotation around the Z axis is irrelevant. For each tilt an angle is obtained in the X and Y axis. It recorded and can be easily reproduced in the master cast

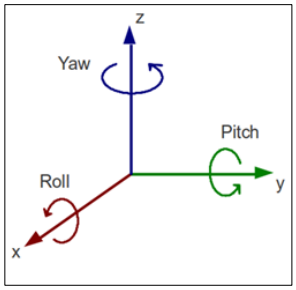


Figure 3: Rotation in 3 planes

Figure 4: Anteroposterior tilt

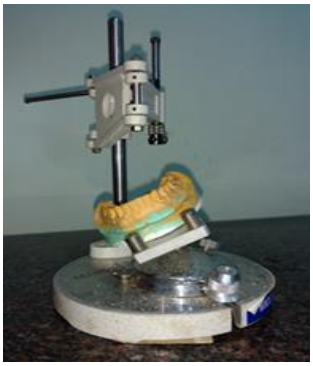


Figure 5: Lateral tilt

Advantages

- The tilt of the surveying table can be accurately can be accurately measured and recorded.
- The sensor is attached to the surveying table using a double sided tape. So the whole assembly can be used on any surveyor

Disadvantages

The surveying table is attached to the platform by a ball and socket joint, some technical skill is required to reproduce the angle by tilting the table by a later stage.

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