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A handheld and convenient occlusal scanner

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ABSTRACT

Idea to determine the alignment of the teeth and jaw placement. This entirely covers the examination of human teeth between the age of neonatal to adolescence where the majority of the teeth issues and problems occur. We know for a fact that humans up to the age of 8 have milk teeth that constantly get replaced so these issues can be diagnosed early and treated accordingly. So this device uses a piezoelectric sensor or pressure gauge to measure the pressure applied while biting. These parameters are analyzed and then fed to a microcontroller where appropriate techniques are adapted to give a detailed analysis and determine the intensity of the issue. This system uses an amalgam of electronics and the medical sector. This is a portable structure that can be implemented in a dentist's workplace.

Keywords— *Occlusal, Teeth imaging, Digital image processing*

1. EXECUTIVE SUMMARY

All disciplines of dentistry require clinicians to assess the force exerted by the occlusion of teeth. Also, most treatment done in dentistry on adults is based on the study of occlusion force. Any observation on open margin, fractures, wedge defects, wear, sensitivity, mobility or failed restoration, there is a always a force related problem at play. Patient's inconvenience, such as frictional, compressive, shear or bending force needs an investigation of abnormal force acting between some or all of the teeth. However, measuring dental occlusal forces has always been complex and often results in subjective decisions. It is in the interest of prostho dontists that the objective examination of the patient for the location, timing, and extent of force imbalance must be ascertained and must replace the subjective estimation for better treatment.

Hitherto, methods used were subjective, such as the use of articulation paper, waxes, pressure indicator paste, etc. There was no uniform method of assessing the force at play and this resulted in non-standard appreciation of the problem by the specialist.

With this background in mind and with current progress in digital and communication technology, it seems viable to develop a sensors-based scanner that can capture the occlusal pressure points and provide a valuable feed- back on the forces that are acting across the dental structure. This pressure information, captured over a specific duration, processed in a processor and displayed on a monitor screen to map the pressure points. This can be further analyzed and evaluated for finalizing the process of treatment. It is intended to develop a scanner system – called T Scan – that can capture the occlusal pressure. This information is transferred on to a system for further processing and to display the denture pressure points. This image can be further analyzed to understand and asses the abnormal forces and to prepare the treatment process.

Although the product is available in international market and can also be imported, the intention to develop a indigenous model that can be manufactured and sold at an affordable cost.

2. GOALS

The goal is to develop a handheld device that captures the dental force / occlusal points over a period of specific time intervals. The information is further transferred to a processor system to develop an image of occlusal points. The current system This image is analyzed using image processing software and various information such as frictional, compressive and shear forces are estimated. The pressure points will be displayed in 2 D or 3 D format along with time line. The prototype model developed will be subjected to evaluation by series of test on patients.

Also, each of the hand held device is associated with a single monitor. Normally, monitor is collocated at the table so as to show the images to patients for his appreciation and

understanding of the problem. Instead of having a big system, a customized processor and monitor can be developed using current technology. These may be connected by wireless devices. The data can also be transferred to a server through wireless communication channel for retrieval and analysis later on.

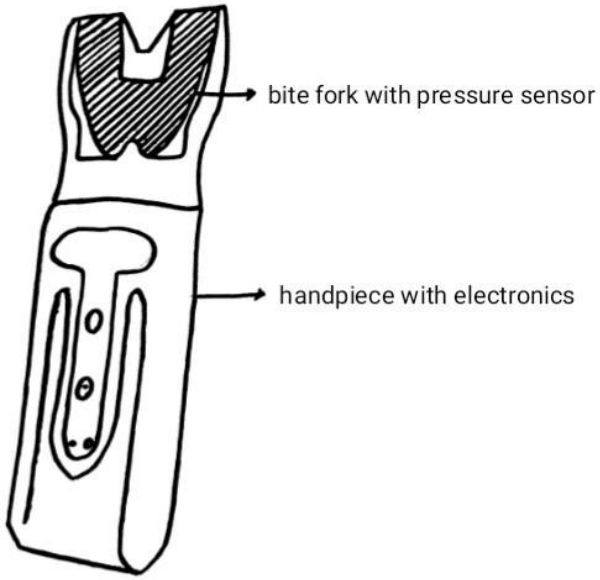
3. APPROACH

The model to be developed has the following system:

(a) The Strain gauge sensor is to be selected that has good sensitivity. The sensor will be enclosed in a thin strip of Mylon. The size and shape of the sensor strip is to be standardized for various age and gender. The strain gauge is to be analyzed for repeated performance and its life. It is intended to develop sensors that will be used for a single patient, may be for multiple number of times in a day for repeated recording of data. On board circuit will facilitate periodic capture of information at regular intervals.

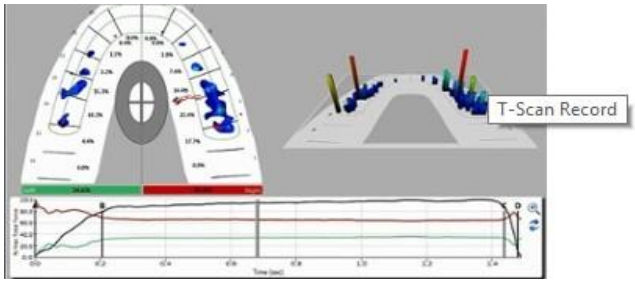
(b) The signal received will be a sequence of pressure data corresponding to each of the triggered period. This signal is processed for removal of noise, amplification and for digitization on board the handheld instrument.

(c) The data transferred to processor is plotted in multiple ways to provide to the appropriate visual clue to the doctor

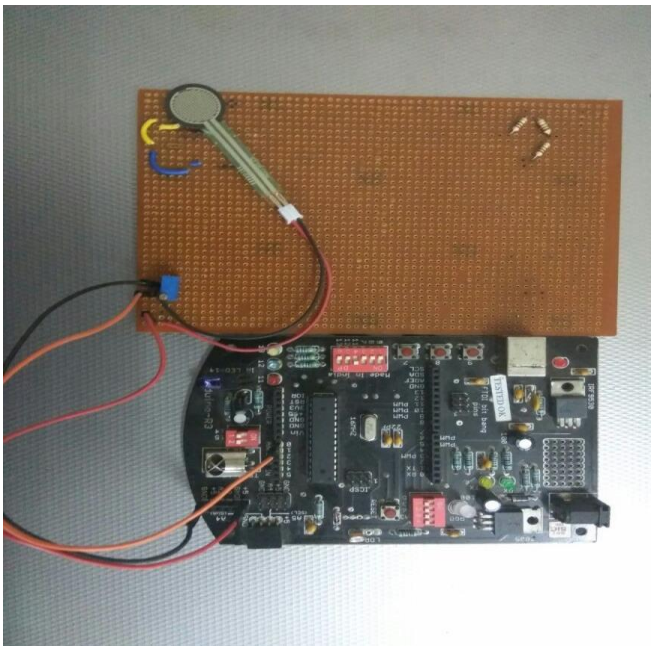


- This design is a prototype of the actual model of the scanner.
- Its design is in such a way that it can fit easily inside one's mouth.
- The model consists of a handpiece with a pressure senor fitted to the end to take pressure values.

3.1 Graphical Representation

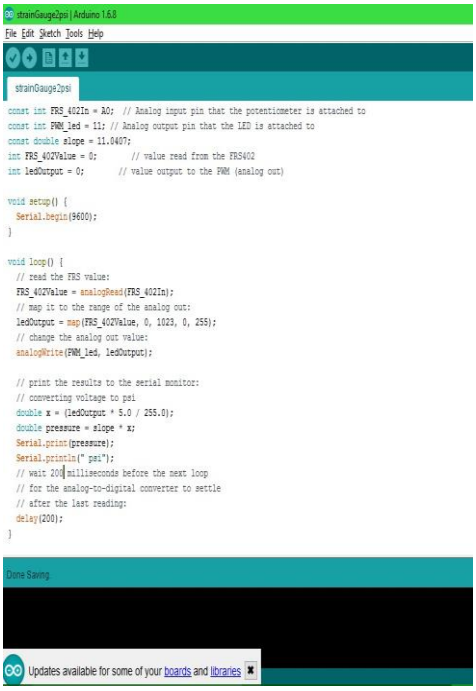


- The values are represented as graphs in the model
- The first part of the graph is a 2-Dimensional representation where the deformities can be viewed
- The second part is the 3-Dimensional representation where the height and width of the deformities are observed.
- The final graph is a signal wave representation of the values

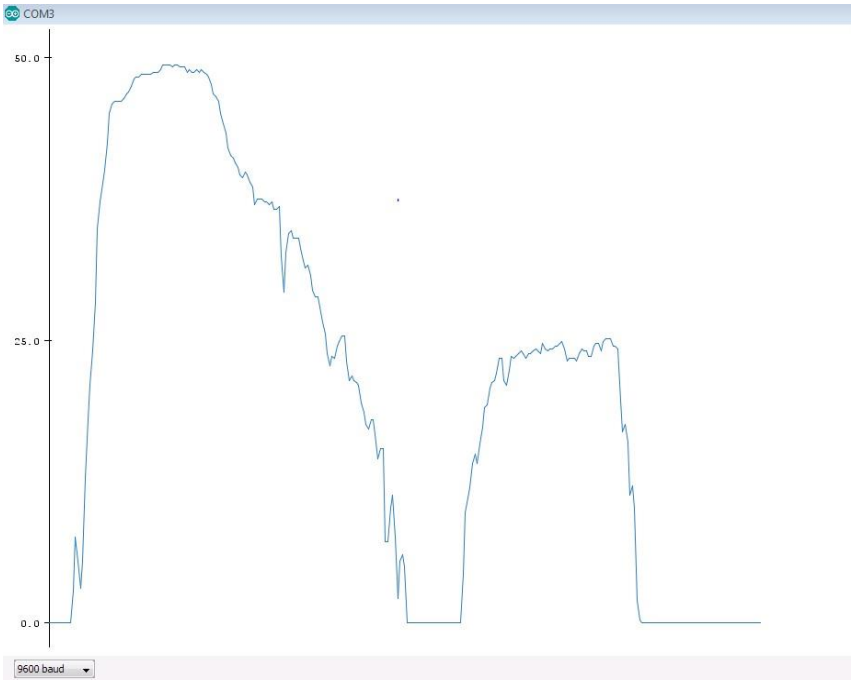


- The apparatus arrangement of the scanner with a simple component arrangement of the prototype.
- This arrangement is used to determine the values for a single tooth as it is minute in design
- The basic components are Arduino, Strain gauge and Mems sensor.

3.2 Coding part



- This part depicts the code used for getting the values from the sensor to the Arduino.
- The data received from the sensor is fed to the Arduino which then converts the received data.
- The received data is in the form of volts which is converted to pascal by the Arduino
- This pascal pressure readings are converted to graphical format



This graph represents the variation in pressure from one point to another and is a visual representation of the change in the pressure readings from the starting to ending time. These types of measurements can be analyzed from various persons at various time intervals with this device, ranging from one single tooth to multiple teeth, this device can help in measuring all values. Also, this can be used in a dentist's palace as:

This can be also reducing the strain of error as the measurements taken from the sensor are precise in most cases, the dentist can compare the readings with their manual readings and there will be nil or very small discrepancies in the values recorded.

This is a revolution in the dental technology as many measures have been employed to find the cause and the amount of deviation in between the teeth and to develop an efficient device to efficiently measure the values. The pressure points are analyzed for various time and duration by time selection of input signals.

4. COLLABORATION

The development of this product is a collaborative effort between the students of SRM Ramapuram ECE department and the SRM dental college.

5. PART OF THE PROJECT WORK

- Designed the hardware portion for pressure measurement in single teeth.
- Circuit diagram of hardware is below
- Controller program for converting voltage of sensor output into pressure reading is below screen shot
- Graphical representation of applied pressure in single teeth

Tale 1: Observation Table

Patient	Left molar (pressure in pascals)	Right molar (pressure in pascals)
A	58	65
B	73	68
C	94	84
D	75	76
E	59	76
F	88	83

6. OBSERVATIONS

We used this device at a dentist's office to measure the pressure of certain patients having teeth arrangement problems.

The patients considered were almost all in the same age group with the maximum difference being 2 years.

Here are some of our observations from the report:

Patient A

- Relatively low pressure on both the sides due to which the force of biting is comparatively low
- Can be rectified by certain jaw strengthening devices

Patient B

- Adequate pressure on left
- Low pressure on right

Patient C

- High pressure on both sides which impacts the normal biting of the patient
- Can be reduced by using appropriate devices

Patient D

- Adequate pressure on both sides .
- Ideal reading for comparison of other reading

Patient E

- Very low pressure on the left side
- Adequate pressure on the right side

Patient F

- Comparatively high pressure but doesn't affect normal chewing habits.
- Almost ideal.

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