PEN DIGITIZER IN MEDICAL EDUCATION

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Abstracts: The unexpected covid -19 pandemic has challenged the medical education. The traditional classrooms were converted into online classes. A blend of Power point presentations and chalkboard remained main stay for E learning. [1] One of the novel teaching tools with advanced technology in medical education is "pen digitizer". The first graphic tablet and stylus similar to the modern tablets used for handwriting detection by a computer was Stylator demonstrated by Tom Dimond in 1957. The influence of Tablet PC [23] a tool similar to pen digitizer in teaching and learning has been studied in various field of education[45] mathematics[6] science [78] engineering [91011]. Till date only one study is available on pen digitizer in field of medical education. Sorte SR and Rathod SB et. al.[12] conducted a study to highlighted the used of pen digitizer in medical education and recommended the utility of this technology for efficient lectures and better student's engagement and satisfaction. This article discusses the component, the technology and utility of "pen digitizer" in Medical Education.

Key Words: Pen Digitizer, technology, Medical Education, Graphic Pad, drawing tablet, pen tablet, drawing pad, digital drawing tablet, pen tablet , digital art board.

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Introduction:

The unexpected covid -19 pandemic has challenged the medical education an unforeseen crisis. The traditional classrooms were converted into online classes. This situation has increased difficulties for the teachers as well as students. It was an opportunity for exploring new technology for medical educators globally. Educational Warrior started quest for innovative teaching learning methods.

A lecture is the most efficient way to incorporate and convey large amount of information in a limited time. The impact of an effective lecture depends on delivering the content logically, stepwise, focused with proper time management. A blend of PowerPoint presentations added with chalkboard serves this basic motto. Many studies are conducted to compare these two teaching aids and a blend of both teaching aids is preferred by medical teachers and students [13141516] [1-4]. Power point presentations and chalkboard remained main stay even for E learning.

Challenging situations brings out the best in people and technology. One of the novel teaching tools with advanced technology in medical education is "pen digitizer". The influence of Tablet PC [23] a tool similar to pen digitizer in teaching and learning has been studied in various field of education[45] mathematics[6] science [78] engineering [91011].

A pen digitizer consists of following components:

1. Hardware
   a. A stylus pen
   b. Writing pad
2. Connection with laptop
   a. Connection wire
   b. Bluetooth
3. Software

1. **A stylus pen**is a small pen like tool. When stylus touches the writing pad, it produces imprint on the screen and the tip position of stylus can be detected on a laptop screen .[17] A stylus give more precise and organize input as compared to the touch screen which is operated by a finger.[18] Stylus pen are of two types viz Passive/ capacitive and active /Digital.

Passive /Capacitive stylus- Passive stylus do not require power. They are made of conductive material like metal rod which transmits the electrical charge between hand and a rubber/foam.[19] They work by interfere with the electrostatic field of the laptop screen's.[20]Stylus tips is large as made up of rubber or foam hence the precise of notes or drawings is compromised.
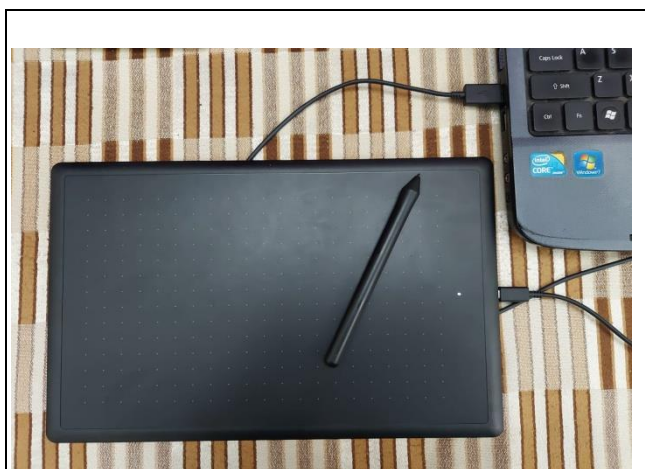
a. Photo showing medium size pen Digitizer

Active styluses are powered by a removable or chargeable battery and contain digital circuitry components within the pen. These circuitry components communicate with a digitizer of writing pad. This communication works on innovative technology like pressure sensitivity, palm detection, eraser tips, memorizing settings, tilt, programmable buttons and writing data transmission. In order for an active stylus to function, its digital component protocol must match the digitizer technology in the touch screen it is interacting with. Some of the examples of active stylus are Microsoft Surface Pen, Samsung S-Pen, Google Pixelbook Pen, Apple Pencil.

Stylus performance is measured by four parameters[21]

1. Comfort
2. Resistance
3. Balance and weight
4. Precision: It depends on following factor
   1. Responsiveness & speed
   2. Jitter
   3. Tilt- angle from vertical of the stylus
   4. Levels of pressure
   5. Palm rejection or detection[22] – Itprevents scribbling on the screen when palm is rested on the writing pad while writing. It works on a blend of technology of the stylus, the Operating System software and the screen digitizer technology.

2. **Writing pad**- It is also known as graphics table, drawing tablet, pen tablet, digitizer, drawing pad, digital drawing tablet, pen tablet, or digital art board. It is a computer input device which enables a user to hand-draw notes, images, graphics and animations, with a stylus in a manner similar to a person writing on a paper with a pen.

Writing pad has following characteristics

* Drawing area – It depends on the writing pad size – Small (4" x3"), medium (8" x 6") and Large (12" x19")
* The resolution size- It depends on the active area, which is measured in Lines per inch (LPI) which is a measurement of printing resolution.[23]
* Pressure sensitivity- The level of modifying the size of strokes with pressure [24]
* The actual drawing accuracy is restricted to the size of pen's nib. [25]

Types of Writing pads

* Passive tablets- It make use of electromagnetic induction technology.
* Active tablets- It contains self-powered electronic technology.
* Optical tablets- It is operate by a tiny digital camera on the stylus.
* Acoustic tablets- it works on the principle of acoustics, the acoustic signal of stylus are picked up by microphones placed near the writing surface.
* Capacitive tablets -These tablets use an electrostatic or capacitive signal.

The connection between the writing pad and laptop can be established with help of a connecting USB wire or Bluetooth technology.

Software used by pen digitizer

Pen digitizer works on various software [26]

* Paint
* whiteboard
* Jam board
* Microsoft office Power point (PPT)
* Autodesk Sketchbook
* Affinity Designer
* Adobe Photoshop CC
* Corel Painter 2019
* Clip Studio Paint
* ArtRage 5
* Krita:

- Pixaki
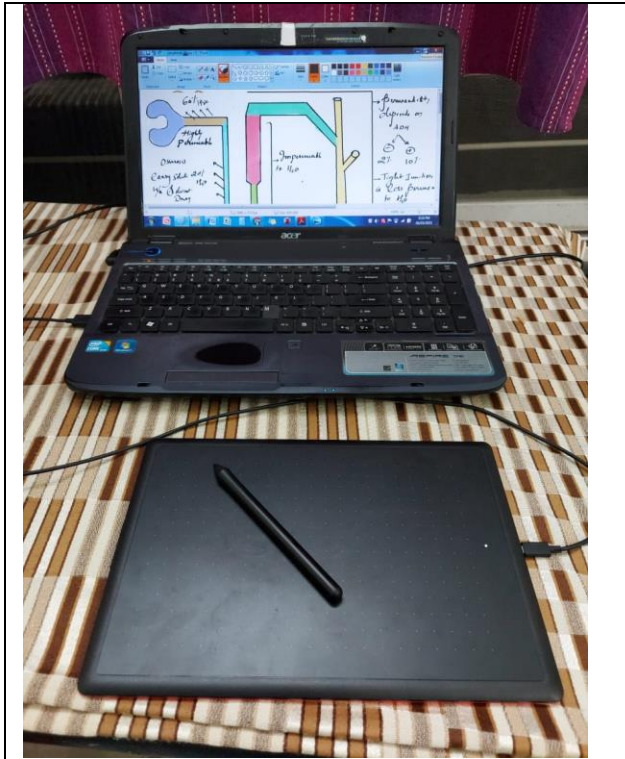
b. photo showing connection of pen digitizer to laptop and the software "paint"

Software Tools of Pen Digitizer

- Writing option- Pen, pencil, brush, airbrush, oil brush, crayon, markers, calligraphy pen and eraser
- Width of pen- Multiple size are available
- Colour option- All shades are available
- Shape option- Preformed shapes are available
- Picture and photos can be inserted and edited

c. Photo showing the Software 'PAINT' Tools BOX

Some of the software are free while some are paid software. After Installation of device drivers and software, the pen digitizer is ready for use. The four corner of the writing pad denominates the four corners of the laptop screen.

Utility of Pen Digitizer in Medical Education

Pen digitizer can be used in following ways in medical education.

A. Online Teaching

   a. **Synchronous teaching:** - In online Synchronous teaching large group of students are taught in same point of time. Using the pen digitizer laptop screen can be shared in real time on E learning platform like zoom, google meet, Microsoft Teams, facebook live, you tube, etc allows students to takes the notes.

   b. **Asynchronous teaching:** - In online asynchronous teaching large group of students are not taught in same point of time. Using the pen digitizer, the laptop screen can be recorded with help of screen recorder to create learning videos. These videos can be shared with the students and they can watch the video at their convenience.

B. Offline Synchronous physical teaching: -

   a. Using the pen digitizer the laptop screen can be connected to projector via HDMI or VGA cable and the screen can be projected on large screen in real time.

The class notes can be saved in various digital format, can be used to summarize the topic at the end of the class, can be shared with students and even can be printed which can be utilized by students to revise and memorize the topic [27][28].

Elisha Gray patented the Telautograph the first electronic handwriting device in 1888[1].

The Stylator, first graphic tablet and stylus developed by Tom Dimond in 1957 was used to detect handwriting by computer [29][30][31].

The use of tool pen digitizer had increased for online classes during covid pandemic. This technology is popular in field of engineering, mathematics, art, science and education and is new in the medical field. It is good tool for teaching medical subject which have diagrams, concepts, sequential steps and concept maps especially where complex visual information or mathematical equations are required.

Pen digitizer is becoming popular among students as note-taking devices, for taking lecture notes while following along with the teacher. Pen digitizer makes easy efficient online educational process. [32]

Till date only one study is available on pen digitizer in field of medical education. Sorte SR and Rathod SB et. al.[12] conducted a study to highlighted the used of pen digitizer in medical education and recommended the utility of this technology for efficient lectures and better student's engagement and satisfaction in the offline physical class. They found a good balance between writing and student comprehension. Use of multiple colours and tools helped to highlights important points and increased the focus teaching. [28333435]

Challenging situations brings out the best in people and technology. Pen digitizer is one among them. This paper had tried to enlighten the use of this novel tool in medical education for better online teaching learning process for educators.

d. Photo of lecture notes by Dr. Smita Sorte

No Conflict of Interest

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