

## Smart Home Technology- An overview

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### Abstract

Oral health care is frequently cited as an area that has witnessed the radical transformations underway as a result of digital revolution. One such innovation is the Bluetooth Technology developed to jazzup dental practice. This technology offers dentists not only tailor the procedures but also to diagnose more quickly, with high degree of accuracy. Henceforth, this review emphasizes on implementation of bluetooth smart technology in various devices for quality dental practice.

**Keywords:** Bluetooth, Smart technology, Smart byte retainer, Cariescan

### Introduction

The Bluetooth is a small microchip that operates in a band of available frequency throughout the world, destined to replace wired connections between electronic devices like cellular telephones, computers, and many other devices. This smart technology can be used at home, in the office, while travelling, etc. It also allows to the users instantaneous connections of voice and information between several devices in real time. Due to its robustness, low complexity, low power, and low cost, it has been well applied in many fields from computers and electric equipment's to household electrical appliances and even in the field of dentistry.<sup>(8)</sup>

### History

The development of the "short-link" radio technology, later named Bluetooth, was initiated in 1989 by Dr. Nils Rydbeck CTO at Ericsson Mobile in Lund and Dr. Johan Ullman.<sup>(4)</sup>

Back in 10<sup>th</sup> century BC, the king HERALD II BATLAND of Denmark, nicknamed BLUETOOTH because of a disease which gave his denture such characteristic color. During his reign, numerous small kingdoms existing in Denmark and Norway working with different rules were reunified. This agenda was adopted for the bluetooth technology and promoted by ERICSSON (SWEDEN), NOKIA (FINLAND).<sup>(4)</sup>

Ever wondered about the Bluetooth logo????...Everybody is well aware of Bluetooth icon, but very few know about its origin. Bluetooth's logo combines the representation of the Nordic runes Hagalaz (transcribed by 'H') and Berkana (transcribed by 'B') in the same symbol (as shown in Fig. 1) This is, HB like Harald Blåtand the king.<sup>(4,8)</sup>

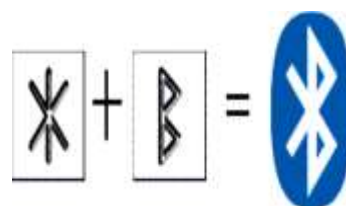


Fig. 1

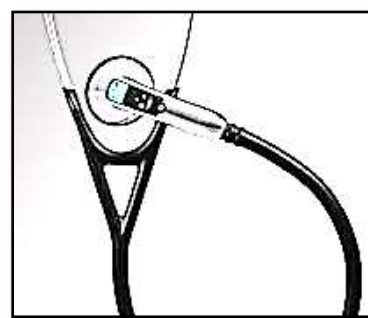


Fig. 2

**Clinical Applications:** Technical advances in miniaturization and wireless communications have enabled development of monitoring devices that can be used in dentistry for general examination on chair side such as for measuring blood pressure(as shown in Fig. 2) heart rate(as shown in Fig. 3), pulse rate(as shown in fig. 4) and blood glucose levels(as shown in Fig. 5).



Fig. 3



Fig. 4



Fig. 6



Fig. 5

**Caries Prevention**

a. **Miniature Bluetooth (Tooth Jewel):** Modern caries management now involves not waiting until end stage disease is evident, but seeking to also identify early stage disease which can be controlled in many cases without ever requiring surgical intervention. The value of early caries detection to the patient is then the ability to control the disease process sufficiently to arrest or demineralize lesions.<sup>(2)</sup>

Caries is caused by specific types of acid-producing bacteria when the pH at the tooth surface drops below 5.5. A miniaturized and autonomous non-invasive pH monitoring nodes were invented which can be attached to the tooth surface for monitoring any pH changes on tooth surface. It could be like a tooth jewel or an invisible tooth colored node involving integrated circuit and system on-chip design that can be attached with composite luting cements.<sup>(2)</sup> (as shown in Fig. 6)

**Parts of micro-biosensor**

**A Digital Micro pH Meter:** Facilitates long term tooth surface pH monitoring and providing real time feedback to the patients and dental experts.(as shown in Fig. 7)

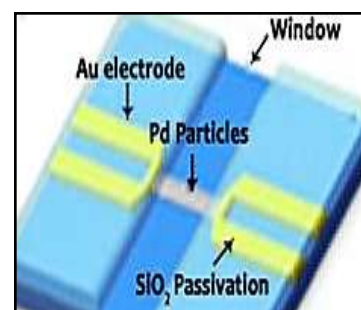


Fig. 7

**Power Supply:** A microfabricated biocatalytic fuel cell (enzymatic micro-battery).(as shown in Fig. 8) This device use organic compounds (e.g. formate or glucose) as the fuel to generate electricity utilizing enzymes (e.g. glucose oxidize or formate dehydrogenize) as its catalyst, through the application of power generation principles found in living organisms.<sup>(5,6)</sup>

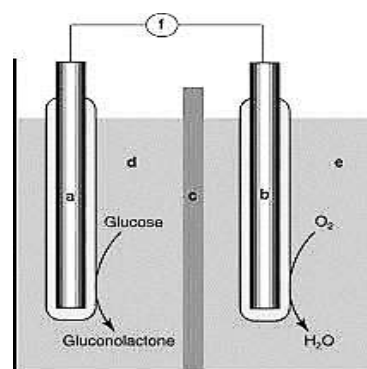


Fig. 8

**Ultra Low-Power Wireless Communicating Device**

When the digital micro pH meter detects the pH lower than 5.5, wireless communicating device(as shown in Fig. 9) sends a caution (e.g. ‘‘you are at risk

of dental caries”) to the external monitoring equipment. The external monitoring equipment will be a mobile phone or a hands-free heads.<sup>(2)</sup>



Fig. 9

- b. **CarieScan:** The CarieScan PRO™ is a small, lightweight battery operated device (as shown in Fig. 10) that is simple to use, automatically calibrated and Bluetooth enabled. CarieScan PRO™ offers the earliest possible detection of caries. This unique device provides precise and repeatable data to monitor caries over time, enabling timely preventive treatment and supports evidence based care plans.<sup>(9)</sup>



Fig. 10

- c. **Tooth Brush:** Smart tooth brushes have entered the field of dentistry to improve oral hygiene and thus prevents dental caries. Combining the smart tooth brush with associated application, users will be able to track their brushing while improving their overall oral hygiene.

Smart tooth brushes have sensors in the head of tooth brush that send information on the individual's brushing habits to an interactive app on smart phone via Bluetooth(as shown in Fig. 11). It records brushing times, duration of brushing at different areas of mouth, amount of pressure to apply and angle at which the tooth brush to be held. Apart from these smart apps also features games, coaching and rewards to appeal kids and adults which further offers additional motivation to brush properly.<sup>(10)</sup>



Fig. 11

### Apexnrg-Blue

An apex locator that implements Bluetooth® Wireless Technology(as shown in Fig. 12) for the transmission, display and storage of measurement data on clinic computer. Automatic adjustment of the measuring current ensures accurate location of the biological apex in changing canal conditions, including dry, wet and bleeding canals. Software is designed to be integrated with either or both digital x-ray and clinic management software already existing in the dental clinic to complement the paperless clinic objective.<sup>(11)</sup>



Fig. 12

### XSmart iQ

It is a continuous and reciprocating motion cordless motor enabled with Bluetooth technology controlled by an Apple iOS application (as shown in Fig. 13). This Bluetooth easily gets paired with Apple iOS. File's progress will be displayed on PC screen via Bluetooth Wireless Technology thus optimizing endodontic treatment.<sup>(12)</sup>

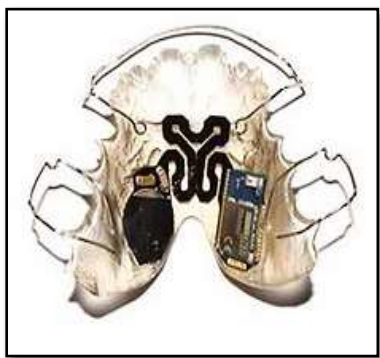


**Fig. 13**

### Smart Byte Retainer

Patient compliance with retainers is a significant concern. Up to 70 percent of patients (and their parents) forget the necessity of wearing a retainer, while wear time is overestimated by a third of actual time. Forgetting to wear a retainer is a leading reason for poor compliance, along with discomfort, the hassle of wearing a device and speech difficulties.

The Smart Byte retainer (as shown in Fig. 14) works through a sensor placed inside the retainer that can differentiate between body temperature and room temperature to determine if the device is being worn. The information then flows to the patient's mobile phone, a cloud database and ultimately to the orthodontist's computer server. An application that accompanies the retainer has the ability to incentivize patients with prizes and other rewards when they reach goals for retainer use.<sup>(13)</sup>



**Fig. 14**

Bluetooth technology has got few drawbacks such as short life time power density also security and privacy of the clinical data remains questionable.<sup>(6)</sup>

### Conclusion

Bluetooth propels into new era in medical and dental fields. Application of this smart technology in dentistry helps in early diagnosis and treatment of various diseases. Implementation of such innovative technology provides awareness on oral health care and thus improving quality of life.

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