# Artificial Intelligence and IoT Implementations for Remote Dentalcare Information Systems

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*Abstract*— **The Internet of Things (IoT) and the Artificial Intelligence (AI) are two technologies growing faster than all other technologies in the world. The transformation of the healthcare sector by increasing its efficiency, lowering costs, and putting the focus back on a better patient care system, is one of the main columns of the smart city idea.**
**Dentalcare is one of the main sectors of the healthcare system. The IoT and AI implementation in dentalcare systems requires a deep understanding of different frameworks in smart cities. These frameworks include the integration of technologies, devices, systems, models, designs, use cases, and applications. The IoT-based dentalcare system mainly employs both AI and machine learning (ML) by gathering different records and datasets. The technology used helps to support dentalcare applications and analyse activities. This paper provides a survey that focuses on the identification of health Internet of Things (H-IoT) and health Artificial Intelligence (H-AI) applications, with focus in dentalcare, supported by smart city infrastructure. Finally, this research contributes to scientific knowledge by highlighting the main limitations of the topic and recommending possible future opportunities in this research area.**

***Keywords: Internet of Things, Artificial Intelligence, Machine Learning, Dentalcare Systems, Healthcare Systems, Smart City***

## I. INTRODUCTION

The population is in an ongoing growth facing the healthcare sector with many challenges. One of the main sectors of the healthcare is occupied by the dentalcare. Indeed, there is a need to address these problems, which this paper aims to do. The internet of things (IoT), resource availability, security, and networking are the main priorities for developers. Smart cities generate and utilize smart solutions as populations increase to create a more conducive environment. If we want to ensure productivity, we need a sound healthcare with focus in dentalcare sector, so that people can perform their jobs with minimal worries. In 2017 T. Alizadeh put forward a smart city model that consists of a patient record system integrated with various healthcare applications that is enabled with IoT devices and machine learning (ML) protocols. The technology and architecture consist of a patient record system that integrates well with the appropriate sensing mechanisms and collects structured and unstructured data for ML analysis. Communication protocols have become essential for transmitting data and signals between IoT devices, systems, and models. Smart cities offer quality of life to their residents. The smart city's communication systems are categorized into proximity wireless, personal area networks, wireless local area networks, wireless metropolitan area networks, and wireless wide-area network technologies.

## II. BACKGROUND

The concept of smart city dentalcare is one that many traditional cities aim to emulate by setting up conventional devices and equipment for integrating dentalcare resources with smart solutions. Smart solutions and information and communication technology (ICT) play a crucial role in ensuring smart cities' success in providing citizens with quality dentalcare services. The smart city's vital goals include making provision for high-quality living, conserving healthcare with focus in dentalcare service quality, and promoting more conducive quality conditions for citizens. There must be a particular model to generate and provide creative and productive dentalcare services.

Different systems, architectures, and frameworks work together for a common purpose, where the essential elements of an IoT-enabled smart city dentalcare system are implemented. A smart city delivers a much better, more comfortable living environment. It also grants citizens the opportunity to be actively involved in actions that benefit their requirements and to be functional members of society. Citizens make use of many smart devices to engage with and utilize these services. Smart service is an explicit, sophisticated network configuration in which a substantial amount of individual data is delivered from citizens using the Internet.

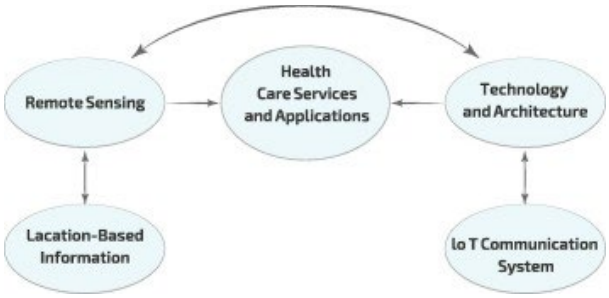


*Figure 1. Basic elements of an IoT-enabled smart city healthcare system*

## III. STATE OF THE ARTS

In a smart city, services are delivered to resolve the issues faced by residential. The practical systems consist of health with focus in dental services and monitoring services. The concept of remote sensing is commonly used in Dentalcare monitoring services with high number of researches and applications. Smart city dentalcare system is a patient record management center (PRMC) that helps collect, manage, and preserve patients' electronic dental records. Important indications internal to the patient, such as x-rays, intraoral images, etc., are sensed and collected. External indications refer to critical climatic conditions, such as humidity and temperature; they are obtained from the medical sensor connected to the patient and transferred to the dental service for further examinations including remote dentalcare services.

The dental monitoring system is a system that obtains information from both the medical sensors attached to the patient's mouth and the smart device of the custodian. The dental monitoring server (DMS) serves as the controller; it delivers an individualized dentalcare plan in real time through an analysis of the current dental situation and historical records. It also generates signal notifications, warnings, and exceptions during periods involving critical situations. The smart service's essential elements include dental monitoring system for evaluation and oversight, clinic service for procuring dental problem identification, and instant reaction. At the same time, the PRMC deals with storing and utilizing information. The dental monitoring system serves the DMS in real time. The clinic system permits dentist specialists to make inferences on the patient's dental status concerning the documented report delivered by DMS and the past dental records obtained from the PRMC, where all personal records are kept.

The PRMC is a central storehouse in which all the dental records and data of patients and the prevailing dental conditions in the digital dental records of patients are kept. The dental monitoring system also has local storage. This storage holds the patient's dental history and dental records as the main requirement for a simplified technology architecture for smart dentalcare system, as shown in Fig. 2. The patient central electronic dental record (PC-EDR) is versatile storage that embodies patients' past dental records and their detailed information, such as name, address, phone number, etc

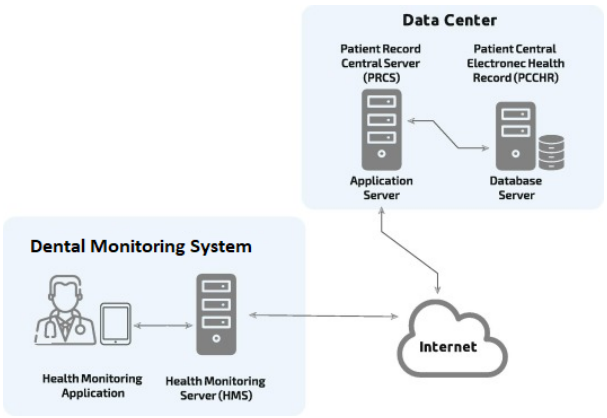


*Fig. 2. Simplified technology architecture for smart dentalcare system*

Sensors, monitoring, and control are required to make dentalcare cities smarter. These sensors' feedback values help dentalcare providers conduct monitoring and control through automation. These sensors' feedback values help dentalcare providers carry out monitoring and control through a series of automation. The IoT, wireless sensor networks, deep learning, and other technologies can be used successfully to accomplish these goals. Smart cities can quickly attend to many people's dentalcare needs at once by having access to real-time information. IoTs, AI, and computing technology have changed the face of dentalcare.

Location-based services work best with smart city data analytics systems and implementations. Data, such as demographics and global positioning, are integrated to locate the user. The data collected are integrated and analysed by the smart city, enabling dentalcare providers to offer the best dentalcare services at the right time and location. The data are collected through smart devices, that have multiple advanced sensors. Longitude and latitude are detected by a location-based information system integrated with a global positioning system (GPS).

## IV. MODELS AND DESIGNS FOR REMOTE DENTALCARE SYSTEMS

The system of dental monitoring within the smart city framework is problematic. The design of such systems requires problem formulation and product. Stakeholders determine the overall concept and prospects of the new system development. This requires incorporating future end users and needs capture for the development of the new system. The focus is more on the smart dentalcare system's goal, starting with a proper initial assessment of the problem and evaluating its workability.

Stakeholders define the desired design and functions of the proposed smart dentalcare system. The required technology and algorithm choice must be thoroughly undertaken in three steps: selecting algorithms and technology, selecting a model and prototype, and solution validation. Appropriate technologies and algorithms are chosen by the designers, which is aligned with the specified needs and requirements, as stated by the users and the stakeholders at the problem development phase. Therefore, in selecting the right technology and algorithms, environmental

considerations are crucial. Within these constraints, the designer develops creative solutions or modifies current ones. IoT-based and AI-based dentalcare systems aim to improve patients' well-being and the life quality of smart city dwellers. There has been tremendous input into developing models and designs for remote dentalcare systems in the last decade.

## V. IoT AND AI DENTALCARE APPLICATIONS, IMPLEMENTATIONS USING SMART DEVICES APPLICATIONS

Another additional component in IoT and AI services is the close monitoring of IoT and AI applications. Research has been undertaken to develop a framework for dentalcare systems that provides a wide variety of analytical data applications for managing data sources ranging from EDRs to medical photographs. While it is inevitable that patients or other users use applications, it is obvious that application development is based on the services required. Thus, it could be said that services are based on what the developer has to offer, while applications are developed to suit the users. Divergent ML methods have recently been used in several related applications in various areas. IoT and AI driven dentalcare systems and technologies have received considerable R&D coverage, as well as how the IoT can assist with dental historic tracking. These new dentalcare items and devices could be seen as part of IoT and AI innovativeness and creativity to provide different clinical interventions.

In recent times, there has been an upsurge in developing devices that work electronically with sensors connected to smart devices that control them. This development shows that smart devices have risen to become drivers of IoT and AI technologies. Integrating IoT and AI with specific disciplines is crucial for achieving quality service parameters, such as perfection, reliability, and mobility across different devices. Different software applications and hardware products have been designed to ensure their compatibility with smart devices, enabling smart devices to become a useful tool in administering dentalcare.

The features added to smart devices today could efficiently carry out the dental checks and data required for the dental condition. Furthermore, advancements are useful in the dental sciences for accurately diagnosing and assisting.

## VI. CONCLUSION

IoT and AI solutions have evolved in the healthcare with focus in dentalcare sector from a simple design to much more complex and smart systems. Where AI and IoT have played an essential part in dentalcare, their implementation was also equally important. The primary purpose of this research analysis was to specify that applications were functional with smart-city frameworks. Moreover, this paper highlighted tools that influenced dentalcare availability. A comprehensive survey of related publications determined which tools and technology could be implemented.

This paper analysed smart-city dentalcare implementation in terms of applicability. The practical analysis was designed to deliver intriguing and unique ideas. This paper also presented a secure and low-cost method to develop a remote dentalcare system, which provided real-time monitoring of patients by employing IoT and AI technology and ML practices.

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