

Relational Data Model in Pre and Post Dental Treatment evaluation using digital intraoral photos

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Abstract: Relational data model represents databases consisting of collection of tables where relation refers to table, tuple refers to row and attribute refers to column. The principal means of identifying tuples within a relation is through **primary key** and a relation reference to another relation through an attribute called **foreign key**. The relational database model schema for pre and post dental treatment evaluation using digital intraoral photos is normalized to 1NF as images are stored in the relation of database as a BLOB (Binary large object) file using SQL and is treated as an atomic value.

I. Introduction

Relational data model is a collection of unique named tables which represents databases where relation refers to table, tuple refers to row and attribute refers to column. A tuple is a sequence (or list) of values which represents a relationship among a collection of data values. The attributes contain only permitted atomic values of same data types called domain of the attribute and should uniquely identify the tuple which states that no two tuples should contain the exact same value for all attributes in a relation which is referred to as **key constraint**. Hence, Attributes differentiate the tuples in a relation.

The logical design of a database is the database schema which consists of a list of attributes along with their corresponding domains and Relation Instance contains a set of specific rows. According to programming language, a relation refers to a variable, relation schema refers to type definition and relation instance refers to a value of a variable. A set of one or more attributes which collectively identify a tuple is

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superkey in a relation and **candidate keys** is one where no proper subset is a superkey. **Primary key** is a candidate key which primarily identify tuples in a relation. Primary key attributes are underlined and chosen from attribute that hardly or don't change. Other candidate keys are called **secondary keys**. A relation reference to another relation through an attribute called **foreign key** and a **referential integrity constraint** should be ensured between two or more relations.

Normalization of data in a relation is analyzed based upon FDs or Functional Dependency (which is a constraint between two set of attributes) and primary key which minimize redundancy, insertion, deletion and update anomalies. Normalization through decomposition also ensures **non-additive join or lossless join property** which prevent generation of spurious tuple after decomposition, and **dependency preservation property** where functional dependency is present after decomposition.

First normal form (1NF) is a relation in basic (flat) relational model that disallow multi-valued attributes, composite attributes and their combinations. Hence, the only attribute values permitted by 1NF are single atomic (or indivisible) values.

Construction of Relational Data Model in Dental Treatment Application

Dental Treatments consist of operative procedures like restorations, extractions, etc. which can be distinctly differentiated between the photographs taken before treatment and the photographs taken after treatment. These photographs are taken inside oral cavity (inside mouth with mouth open) by a hand held Digital Camera of suitable resolution. For example, a lower molar tooth affected by dental caries and is seen in

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the photograph as a distinct morphological changes of cavity requiring a restoration as treatment (Pre Treatment Photo). The same tooth is restored (treatment done) with silver amalgam (Post Treatment Photo).

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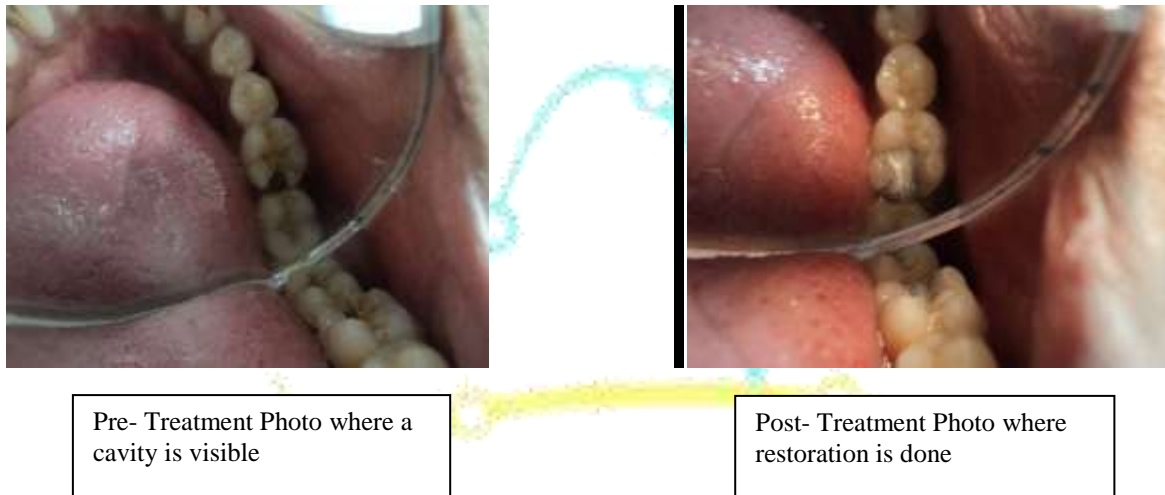


Fig 1: Dental Digital record of treatment

Relational Data Model is created for pre and post dental treatment digital intraoral photos in dental applications of comparison and evaluations. The database schema design is done with attributes as ID, Date, PatientName, Age, Sex, ClinicalExamination, PreTreatmentPhoto, TreatmentDone, PostTreatmentPhoto and FurtherManagement.

The relation is uniquely named as *DentalTreatmentImageRecords* with ID as the **Primary Key**. The database is named as **Dental Digitization and Image Records**. The Database Schema (logical design) of relation *DentalTreatmentImageRecords* are as follows: DentalTreatmentImageRecords(ID, Date, PatientName, Age, Sex, ClinicalExamination, PreTreatmentPhoto, TreatmentDone, PostTreatmentPhoto, FurtherManagement)

The tabular form of database schema of relation DentalTreatmentImageRecords are as follows:

<u>ID</u>	Date	Patient Name	Age	Sex	Clinical Examination	PreTreatment Photo	Treatment Done	PostTreatmentPhoto	Further Management

(Implementation is done in MS Access 2007)

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Although several higher normal forms, such the 4NF and 5NF have been defined, the relation schema is normalized to 1NF as images are incorporated in the relation of database. In the relation, the entire image object or file is treated as an atomic value, which is stored as a BLOB (Binary large object) using SQL. CLOB (character large object) data type is used for large characters. Hence, the relation maintains 1NF status for practical purposes and the image object is treated as an atomic, single valued attribute.

Conclusion

Due to very high prevalence of dental diseases like tooth decays and gum diseases requiring treatments, relational data modelling can be extensively applied in dental applications for visualization, comparison and evaluation of dental treatments.

References

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