Advance Articulated Entity Relationship (AAER) Diagram for Relational Database

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Abstract

The Entity-Relationship model (ER) is a systematic way of describing and defining many systems. The Articulated Entity Relationship (AER) is an improved model from ER-diagram by adding Functional Dependences (FDs) and normalization levels in automatically form. This paper proposed an methodology to add a new notation exactly for weak entity type and relationship between the two entity types. This notations added to the AER-diagram to facilitate the conversion from one form to another, and to make it easy to understand by the user. In addition, to it reduces the time spent by developers and designers to transform the ER-diagram to the relation (table) quickly without having to re-conversion of more than one person in the database. So, the notations define the important information in this stage. That added when convert the AAER-diagram to relation(table) in database or other form. The new notations determine the special information, such as the composite primary key for weak entity type and the primary key of the entity type that become foreign key in the other relation of other entity type according to the cardinality of the relationship. In addition, to the weak entity type and relationship between the two entity types special attributes for each one in his relation, and determined composed attribute. It be explained in detail with examples in context of this paper.

Keywords: Relation: table

1. Introduction

The methods of modeling and representation of relationships, entities, attributes and management of databases in a growing and constantly evolving. The entity relationship diagram (ER) is the first step, which is the representation of entity types and their attributes and relationships between these entity types to each other. Development is to facilitate the process of conversion from one format to another according to user requirements.

The Articulated Entity relationship (AER) is one of the ways in which added some advantages on the (ER) that make it easier to use. Worked on adding and automate the Functional Dependency (FD) and the representation of its own relations in multiplicity representations form [1]. Work a special notation to represent and draw the (FDs) between the entities attributes, and this by representation the multiplicity representations based on the nature of the (FDs). Then add three levels of normalization processes 1NF, 2NF and 3NF.This is in sequential steps, making it easy to trace the user.

The first paper [1] AER focused on the work of the special notation to represent the (FDs) between the special attributes of the entity types only. To make it easier later converted to other forms. Is not touched to the entity type itself, especially the weak entity type. It do not work on the relations between these entity types. So, there are some of difficulties facing the user in the conversion of the weak entity type, in particular relation in diagram to relations form. In this state they need to define the primary key and the attributes of their own directly, which must be placed in their independent table schema.

For this reason leads to the difficulty of retrieving data which leads to increase time spent on retrieval by the user.

This paper proposed an methodology to make special notations for weak entity type and relationship between the two entity types .It specially to them to make it easier to turn them from the AER-diagram to relations and FDs. This new notations determine the composite primary key for weak entity types and determine attributes, which must be with them in the table. It also specifies the attributes of the relationship between the two entity types if it found and primary key for each relationship in a separate table directly. So, this stage will be added and integrated with the first step of the conversion of the ER-diagram to AER-diagram (AER-diagram first step).

There are many advantages of the proposed methodology. One of them is saving the time of the developers and designers of the database. The second one is speed up the process of retrieving data from the database for the end user. The third advantages is do not affected by the deletions and additions and modification of the properties of the entities.

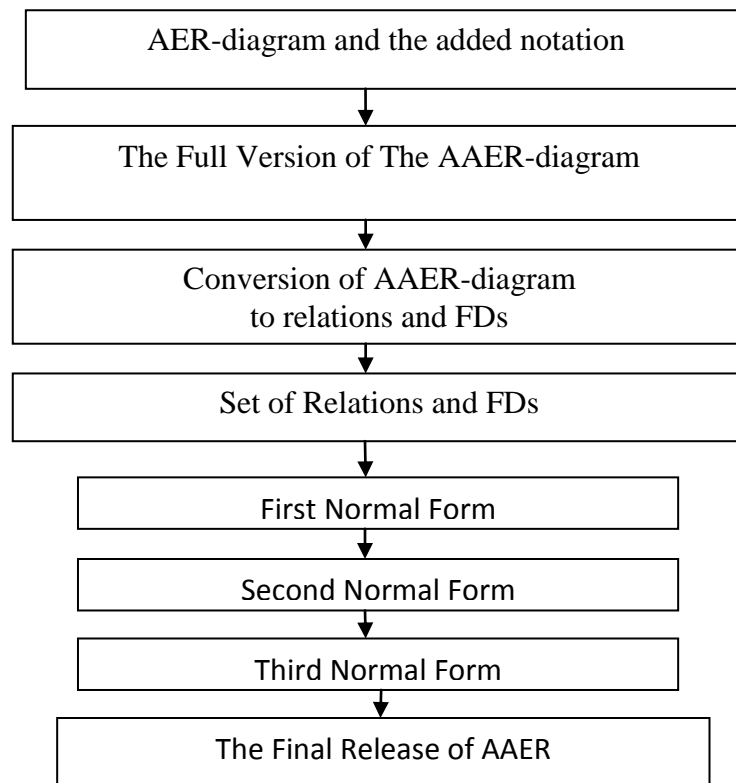## 2. Overview for the Proposed Methodology AAER

Figure 1. Block Diagram with Full Notations for Proposed Methodology (AAER)

The AER-diagram presented the functional dependencies and the steps of normalization in automation form. In this stages only, the time is spent when conversion AER-diagram to relations and FDs. The developers and designers spend his time on converting the AER-diagram to the relations. So, this is without add stages to facilitate this process.

The components of the proposed methodology AAER (overview) are shown in Figure 1. We add a new stage in the first step, to add the special notations. This notations is design for weak entity type and relationship between the two entity types in a special

form. That facilitates the conversion process to other forms on request later. Then we have to continue the steps of addition of FDs and normalization. Finally, we get the final release from the AAER-diagram. The following subsections describe each process in details. To decrease time on all users and developers and designers of the databases.

2.1 Details About the AAER-block Diagram Steps:

The first step, it is take the AER-diagram and add the new notations for the weak entity type and the relationships between the two entity types into the diagram. In the second step it will get the full version of AAER-diagram with all addition. To be fully represented to enter the third step.

In the third step it will be start to convert from form to another. It is convert the AAER-diagram to the relations and FDs. The relations will be very easy to convert, because of the recent additions. In the Functional Dependences(FDs), it will be identifying one attribute or more based on the other. In addition, it will be better and easy to track by the user.
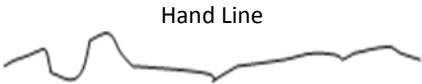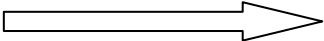
After ending the third step, it will be produce total of relations and FDs in the final form of forth step, then prepare to enter the next step. In the fifth step, it take the set of relations and FDs and convert it to the first normalization form. It is remove the multi-values and the redundant record, and determined the primary key it based in the FDs.

The sex step, it be enter the first normal form to be convert to the second normal form. Make it by remove the partial dependencies that means when a non-key attribute is determined by apart of the composite primary key not all parts of primary key. This step considered as input to the next step.

The seventh step dependant on the complete steps five and sex, and in this step must be remove the transitive dependency. That mean when a non-key attribute determines another non-key attribute. In the final step, it will get the final release of the AAER-diagram with new special notations.

2.2 Table to Describe the New Notations:

Table 1. Shape and Explain the Functionality Notations for AAER-Diagram

Notation Number	Description	Graphical Representation
1.	To refer and determined the primary key of the weak entity type and relationships between two entity types.	Hand Line
2.	Refers to the all attributes of relationship between two entity types and weak entity type and the composite attributes.	Monocular arrow
3.	This notation is specially for relationship among two entity type depending on the type of the relationship, to determined which the key in entity relation become foreign key in other side entity relation.	Double arrow

In Table 1. Show three type of notations where added in the AER-diagram to achieved the AAER-diagram. Defined the functionality of this notations, and what is the information can be extract from the AAER-diagram? by using this notations. Three

different shape of notations to make special function in the AAER-diagram, and make it easy to understand by the user.
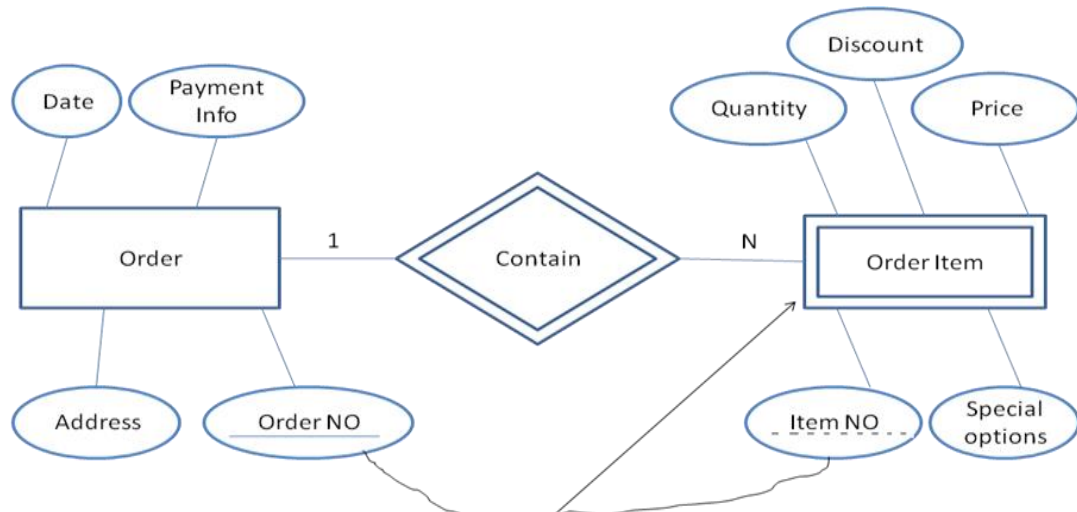
3. Example:

Figure 2. Weak Entity Type Notation

The Figure 2 show how can extract the information of weak entity type from the AAER-diagram. The new different notations extract the composite primary key that contains the partial key of weak entity type, and the primary key of other entity in the other side. In addition to determined all attributes of weak entity type, that will be with composite key in the relation. In this state use just two type of notations.
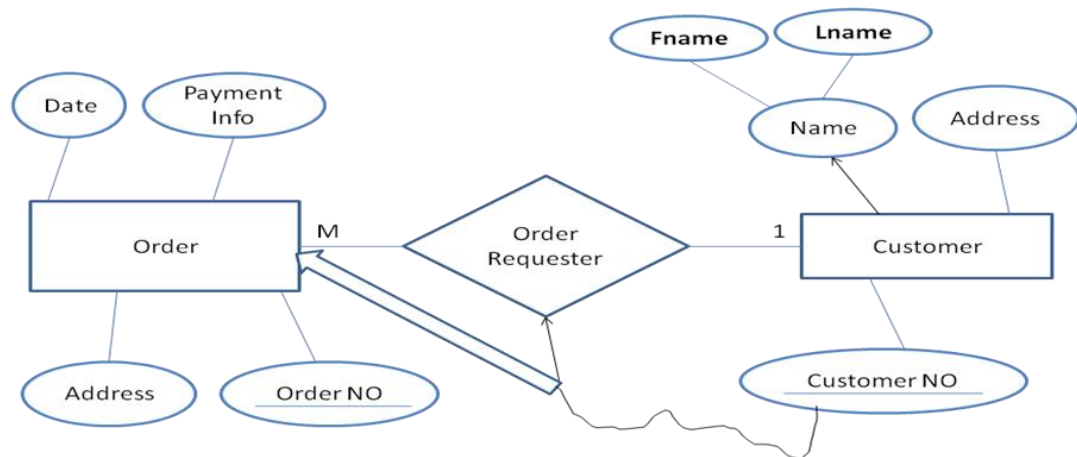

Figure 3. Example for 1:M Cardinality Relationship

The cardinality of relationship between two entity types is very important. This for determined which of the keys of two entity types become foreign key and put it in other entity type relation. Use the three types of notations to determine the attributes and the primary key that became foreign key. In addition to talk the recent information and put it in the other entity type relation by pointing to it.
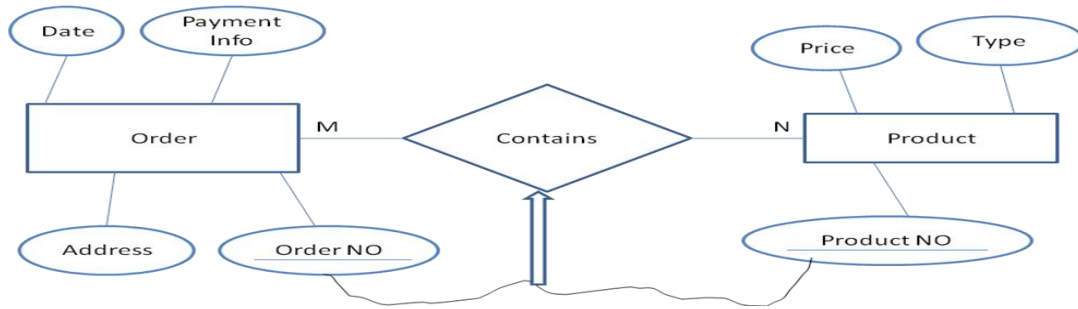
Figure 4. Example for M:N Cardinality Relationship

New relation has created in the M:N cardinality. The notations refers to the primary key for each two entity types. Make it as composite key for the new relation of relationship between two entity types. Also determined the attributes of relationship if found, and put them in separated relation.
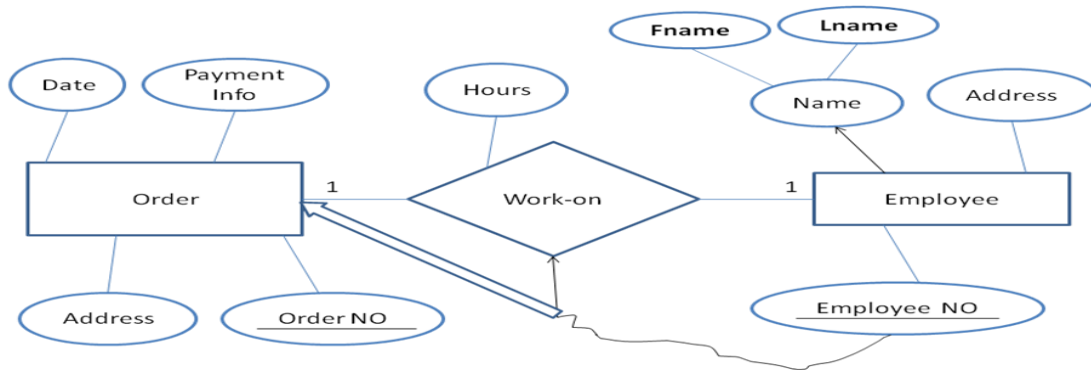

Figure 5. Example for 1:1 Cardinality Relationship

Decision here is optional in 1:1 cardinality relationship in which side of entity types relation put a key as foreign key or as primary key. The type one of notations determined the key that become foreign key. The second type of notations determined the attributes of relationship if found. Also put in the relation which contains the foreign key. The third type of relation is to refers to the entity type which put the foreign key and the attributes of relationship between two entity types in his relation.

4. Limitations

The proposed methodology AAER-diagram are more complex than the AER-diagram. The AAER-diagram added new notations for special subject in AER-diagram. This is make the process of convert AAER-diagram to relations (tables) very easy, but the extra notations where added make the diagram unordered and there are a lot of information in it. The size of AAER-diagram is large, this causes a lot of time consuming to retrieve information from the diagram. So, it will include the proposed solutions in the future work.

5. Related Work

In [1] the P. S. Dhabe, et.al. Proposed the Articulated Entity Relationship (AER) diagram. The AER is an extension of Entity Relationship (ER) diagram that representation the Functional Dependency (FD) information as its integral part for complete automation of the 3 level normalization. The AER-diagram considered as input and then normalized the database to convert to the other forms. Can be represented

mathematically the AER-diagrams representing the ER and mathematical definitions represent the (FDs) . Any changes occur in the diagram are modified automatically to suit the (FDs) information . In addition can be verified from the AER-diagram and it is normalization through mathematical foundations dependent on the ER-diagram.

Many tools developed for different purposes for [2,3,4] papers. In [2] the normalization of relational databases confined to the conceptual level by Dr. M. S. Patwardhan, et.al. The FDs were added on the ER-diagram has achieved a great achievement. To facilitate the process more, released program implemented on the integrated development environment (IDE) and named the AER IDE. The extended design Graphical Editing Framework (GEF) and Draw2d plug-in functionality of Eclipse. The AER IDE helped in the drawing, Storage, validate, and the normalization of the AER diagram. Therefore easy making the process more visual process easy to understand and translate the process rather than theory. Work in [3] explain the way to draw diagram a semi-automatic for marking on the semi-automatic diagram . Also through the use of a schematic drawing tool which extracts contextual information by selecting the graph matching components in the student schemes. This tool will help to change the traditional drawing to make the evaluation process more suitable for the marks to be semi-automatic. That ambiguity disappears in the contextual meaning for each component of the process of drawing during the marking. Which increases the opportunity to understand the student's ideas and taking feedback. In [4] describe architecture of ER-draw, and the details of its implementation and translation of the XML. This tool consisted of XML, OO and relational database theory. Shuyun Xu, pt.al. Use the ERML to facilitate interoperability of various practical tools for the ER diagram. Also draw connotations confirm that the validity for ER diagram.

The writers work in [5] search about the issue of understanding the diagram. This by proposing an experimental methodology to determine which of these two notation full (Chen and SSADM entity relationship diagrams) to be easier to understand by the user. In addition to that there is a target changes on the individual notation. There are presented the results of the best deals on both, with the results of partial variables relating to the individual. Here it is possible to set up an experimental framework to compare the two representations of the symbols methodology. So comparing individual differences in the overall composition and understanding of the notation.

Extracting the ER-diagram from other forms done by many researchers like in [6-9] papers. N.Mfourga work in [6] supports the idea of framework for the extraction of the ER-schema from a set of form model representation schemas of an operational relational database. Doing a reverse transfer of operational relational database to ER-schema. This approach is used on a large scale of data, and there is no constrain assumptions in input of database. This approach works to take all the data extracted from each form, and then works its structure as input to operational relational database. These schemes are used at a low level for the rebuilding of a conceptual scheme, such as the ER-schema. Valerio Cosentino, et.al. Write paper [7] that focuse on the completion of the current database reverse engineering methods of enriching the generated the (UML) conceptual scheme with a number of integration and derivation OCL constraints, through rules of inference scheme in databases. This technique has been implemented by the ORACL language. Applied in a manner where the reverse engineering model to extract UML / OCL model of the database application. Thus, the derivation rules are a very important part of the database. Dowming Yeh, et.al. Presented in this page [8] approach called DBRF. This approach supports extracting an extended entity relationship diagram from a legacy database based on tables. In addition to a few details about the fields, and the lack of details or clarification of the primary key. This approach take the system display forms, table schema and data instance as an primarily input to him. This approach consists of four main steps. First utilizing screen displays to construct form instances. Second, code analysis and data analysis involving comparisons of fields and decomposition of fields are

applied to extract attribute semantics from forms and table schemas, third determination of primary and foreign keys plus constraints of the database system. Finally, conceptualization, with the processes of table mergence and relationship identification. Peter pin -shan chen explained in [9] method to convert English sentences for ER diagram. This method describes how to convert the sentences that contain a description of the entities, and their attributes, and the relationships that connecting them to form the ER diagram. And proposes a set of rules for conversion, based on the English language constructs. Such as verb, noun, adverb, adjective, clause, and gerund. They also depends on representation of the text in easier way for the use of these rules in the conversion for the ER diagram.

There are many approach and variant method for different purpose in the database concept [12, 15, 14, 16, 13, 10, 11]. For example the Márta Czenky implemented normalization method to enhance the efficiency of learning process of normalization [12]. Muhammad Fahad proposed approach to convert the ER-diagram to OWL, depending on the group of rules to facility the understanding process of OWL[15]. Other writers like Yannis Tzitzikas, *et.al*. Proposed methodology to understand the complex and the large ER-diagram[14]. New algorithm has developed by Yen-Ting Chen, *et. al.*, To extract and driven the data as data warehouse from the ER-diagram, and create the dimension table and fact table to calculate the minimum distance between them[16]. The Subhrajyoti Bordoloi, et.al. Proposed an approach to described and explained the database table among reference in easy way[13]. Another benefit of the AER-diagram conducted by Vijay Laxmi, *et.al*. This by using the AER-diagram to contain the information of functional dependences(FDs) as important part of the automation process of the normalization. In addition to made it as a feature to do delete, addition, and update on the attributes[10].The Amir Hassan Bahmani, et. al. Proposed method to do normalization of the relational database in complete automation form. It made matrix for the functional dependence(FDs), and after that generating in with normalization levels 2NF, 3NF, and BCNF, also to determined the primary key from previous information[11].

6. Conclusion and Future Work

This paper proposed methodology to talked about adding special notations to the exiting AER-diagram. This special notations is private to the weak entity type and the relationship between the two entity types it is added on the AER-diagram, until we get the AAER-diagram with new notations. The notations are designed to facilitate the understanding, and to make it easy to conversion to relation (table) or another shape, depending on the need of the users. However, in this paper the focus is on the conversion to the form of relation.

The notations of the weak entity type refers to its composite key, and the all attributes contained in a separate relation. In addition, the notations of the relationship between the entity types it also depends on the cardinality of the relationship. It has added three different shapes of notations. The first one indicate for the composite key of weak entity type and the same shape to the primary key of the relationship. The second one are indicate to the all attributes of weak entity type and the attribute of the relationship If any. The final shape it is special for the relationship to decide in which relation must put the foreign key to indicate to the primary key of the other relation. That explained and clarified in the context of this paper.

In the future work, It would be advisable develop new tool for facilitate the process of adding the new notations to make it easy the change on AER-diagram in automatically form. In another studies may be convert the AAER-diagram to other form depending on the needs of users. It is also possible make update on the all notations (AER and AAER-diagram notations) arranged in the diagram of AAER-diagram in order to avoid increasing the size.

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