Smart Solutions For Railways

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Abstract *: The explosively growing demand of Internet of Things (IoT) has rendered broadscale advancements in the fields across sensors, radio access, network, and hardware/software platforms for mass market applications. In spite of the recent advancements, limited coverage and battery for persistent connections of IoT devices still remains a critical impediment to practical service applications. In this paper, we introduce a cost-effective IoT solution consisting of a device platform, gateway, IoT network, and platform server for smart railway infrastructure. Then, we evaluate and demonstrate the applicability through an in-depth case study related to IoT-based maintenance by implementing a proof of concept and performing experimental works. The IoT solution applied for the smart railway application makes it easy to grasp the condition information distributed over a wide railway area. To deduce the potential and feasibility, we propose the network architecture of an IoT solution and evaluate the performance of the candidate radio access technologies for delivering IoT data in the aspects of power consumption and coverage by performing an intensive field test with system level implementations. Based on the observation of use cases in interdisciplinary approaches, we figure out the benefits that the IoT can bring.*

I. INTRODUCTION

The railway has been playing a fundamental role of public transportation since the 19th Century, in which a steam locomotive began to be run. From that moment, the railway was regarded as a core method to transport massive population moving along the determinant paths within and between metropolitan cities. The basic technology of the railway has been so far progressed and recently enables a high-speed railway system which satisfies the public demand on travelling a far distance. The railway possesses the inherent characteristics of high capacity and energy efficiency, and those merits motivate the governments of many countries to encourage and support the railway for public interest. Consequently, the governments consider the railway significant when they establish transport policies.

II. LITERATURE SURVEY

The objective of railway maintenance is to keep the railway system on performing its functions in good condition during the lifetime. Under the aforementioned CBM concept, a maintenance staff inspects the condition of each entity in the railway system and repairs or replaces it if necessary. The upper part shows the detailed procedure of the CBM. The first step is to inspect each maintenance target according to a guideline specific to the target. For each target, the maintenance staff directly visits the site and measures various

Based on the analysis of the measurement results, the staff decide which status each target is in and whether the target needs any maintenance actions. The candidate maintenance actions are then prioritised based on the significance and criticality, and the budget for the maintenance actions is negotiated, which bounds the range of the execution for the maintenance actions.

III. METHODOLOGY

System Architecture and Function

- **System architecture**
- **System function**
- **System design**

1. System architecture:

The database layer: The database is used to hold data, including user registration information, ticket ordering information, ticket information and all of the other information.

The application service layer: The application service layer is the core of this three-layer structure, the system functions and business logic are handled in this layer. In this layer, the system's business logic is encapsulated, the application service interface is provided for the user interface layer and the system modules between the function calls. The application service layer also updates data in the database, according to the service request of the top layer.

indices dedicated to the target at a specific inspection period.

The user interface layer: The user interface layer is a program that runs on a remote user computer. It displays the provided services by the server to the user. When the user selects a service, this program sends a request to the server. When the server returns the processed result, this program shows it to the user.

2.System function:

The system functions are as follows: customer register function, customer cancellation function, searching function, booking function, refunding function.

Customer register function: Customers could order tickets after they login on the system. The registration information includes the user's name, user's telephone, user's address.

Customer Cancellation Function: According to the customer's cancellation request, the system could complete the cancelling operation, delete the user's registration information from the table in the database. searching function: Customers can use the train number or site to site to query. When they type the information, the system will return the relevant information to customers, including the type of train, the type of the tickets, the number of remaining tickets, the price of tickets. booking function: Customers could order tickets after they

login on the system.They could select the Train Number, site interval of trips, the number of train tickets.refunding function:Customers may refund their tickets for some reasons.The system checks tickets information to determine whether to allow refunding tickets, then returns the process result.

3.System design: The system design includes business process design and database design. Business process design implements the order of various functions and links between the various functions. Database design mainly realises data tables and the relationship between data tables.

3.1 Business Process Design

The following business process is made after a detailed analysis of business functions about railway online booking system.

- Customers register personal information, so they can order tickets in the system.
- Customers search train information through the system and see whether having appropriate tickets.
- Customers order tickets on the user interface.
- The system returns the result of ordering tickets information.
- Customers can select cancelling operation for some reasons, so the personal information will be removed from the system.

3.2 Database Conceptual Design:

In the database conceptual design phase, the entity - relationship diagram can be used to establish the data model to form a ER graph model independent of the machine and DBMS. ER diagram provides entities (i.e. data object), properties, and associated methods, in order to describing the conceptual model of the real world. The basic elements of ER diagrams are constituted by entities, attributes and links. The representation is as following:

- **Entity type:** It is expressed by a rectangle. The entity name is written in the rectangle.
- **Attribute:** It is expressed by oval and linked with the corresponding entity by line; multi-valued attributes are connected by the two-lane; line is added under the name of the main attribute.
- **Contact:** It is expressed by the diamond and linked with the corresponding entity by line. The contact name is written in the diamond box. The contact type is written in the line. The relationship of 1 to 1, 1 to n, n to m should be clearly shown in the ER diagram.1 to 1 relationship between the two entities connected in the direction of writing 1; 1 to n relations in the one to writing 1 and multi-party write N; n to m relationship between the two entities are connected in the direction of writing N, M.

3.3 Logic Model Design

Logic model design task is to convert the basic ER diagram of the conceptual models to logical structure of the consistent data model which was supported by DBMS products. In this paper, the user view method is used for standard tables. All the keywords of tables are listed. The contact and constraint relation is described by a data collection chart. The design result of the user view is summarised. All of the user view tables are composed of a complex database system.

The logic design of database: Customer information , name, password, sex, telephone, address, paid account, paid type Order record , ticket ID, count, date, total price, Ticket message ticket ID, residue number,date, start station, end station, price Train message (train ID, train type, start station, end station, start time, end time, distance)

Physical design of the database: The physical structure of the database mainly refers to record format, record organisation and record access methods. Obviously, the physical design of the database entirely depends on a given hardware environment and database products. In relational model systems, the physical design is relatively simple because the file format is a single record type file which contains only index mechanism, space size, block size, etc.

IV. CONCLUSION

In this paper, we design and achieve a railway online ticketing system. The system is structured into the data access layer, business logic layer and business exterior layer. We implement customer registration, customer cancellation, ticket inquiries, online booking, online ticket refund in the system . Business process design and database design is the focus of this system which are clearly and effectively designed by the business process diagrams and database ER diagrams. Real-time tickets messages will be feedbacked to customers by the online railway booking system. The efficiency of booking is improved, manual booking errors is reduced, the management of railway passenger transport and customer booking is facilitated.

V. REFERENCES

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