LAMF: Lighting Adjustment for Mood by Food

RFID Based Context Aware Food Ordering and Lighting Control System at Restaurants

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***Abstract*— A Ubiquitous environment is expected to provide appropriate services based on the identified context regardless of time and place. For satisfying this demand, activated communication among participating objects is essential. RFID is in the spotlight as communication means due to its economic feasibility and expandability and has been attempted to be applied to various domains. The system proposed in this research is a part of smart restaurant system that automatizes food order, bill payment and mood associated lighting control depending on the served food types supported mainly by the RFID technology. This efficient and innovative system could not only reduce time and cost for managing a restaurant but also provides synthesized real-time mood lighting for the customers to enhance their emotion rich dining experiences.**

Keywords— RFID; Context Awarness; Restaurant; Food Ordering; Payment; Mood lighting control;

I. INTRODUCTION

Advances in ICT bring a ubiquitous paradigm that offers various services based on the context awareness technology. This ubiquitous computing environment is subject to certain conditions such as autonomous actions depending on the automatic awareness of context, development of technology about information process. [1].

Currently, RFID (Radio Frequency Identification) technology has been also spotlighted in accordance with the advancement of ICT. This is sort of recognition technology using small tag containing unique information attached to the object to be identified.

RFID technology has many advantages compare to other recognition methods. Firstly, the tag is quite low price so it can be widely used in numerous domains. Secondly, it can cover a variety of areas by applying different frequency or using battery for fulfilling diversified detection requirements. Lastly, RFID could maintain efficiency and accuracy even through non-contact detection method. In case of industry, numerous manual tasks can be automated by RFID technology. These are the reason why RFID system is one of the most widely used automated technologies in industry domains. [2]

A RFID based smart system proposed in this research is focused on automating restaurant services especially for food ordering, mood lighting control and payment process. Currently, most of restaurants have many unresolved management issues such as errors in order processing, service delays, and potential sources of cost increase that could not be immediately reflected in the escalation of dining budget on customer's part. However, these drawbacks can be improved through computerization and automation using RFID technology. Thus, we carried out the development effort of a smart table system harnessing RFID technology. This system can provide both merchandisers and customers with satisfaction through automated ordering, payment and sophisticated mood adjustment for exhilarated dining experiences.

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II. DESIGN OF LAMF SYSTEM

A. Function Definition

LAMF (Lighting Adjustment for Mood by Food) system mainly works as if it were a single unit for individual restaurant table but it actually would be networked with other table units. Not only this provides customers with automated services for their convenient and enjoyable dining but also offers a more simplified restaurant management scheme for the owner and manager of the restaurant. We largely divided our proposed system into three main use cases of food ordering, lighting control and payment processes as shown in table 1.

TABLE I. FUNCTIONAL BLOCKS OF THE LAMF SYSTEM

Use case	*RFID tagging*	*Functional Specification*
Ordering	Attached to the miniatures	Computerized and automated food ordering using the RFID tags attached to specific food associated miniatures
Lighting control	Attached to the dishes and cups	Lighting brightness and color adjustment through identified RFID tags attached to the concups and dishes that contain the ordered foods
Payment	Attached to the miniatures	Calculating the bill and sending that information to the counter based on the RFID tags attached to specific food associated miniatures

B. LAMF's System hardware architecture

The hardware composition of the LAMF system is divided into two groups according to the type of their connectivity. The first one is server group that receives the identified context information from each table and controls the whole system.

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The second one is table group that detects the RFID tag, sends that information to the main server and provides the customer with automated services. Figure 1 represents the whole hardware integration pattern of our proposed LAMF system.

The Server group is composed of Main Server, POS System and Kitchen Monitor. These components are connected to each other through a Local Area Network. Main Server receives the detected information from RFID reader of each table and hands it over to the Kitchen Monitors in checkstand. The order information is sent to the Monitor for kitchen processing and orders plus payment information are also transferred to the POS System of Counter for automated payment processing.

The Table group consists of RFID Reader, RFID Tags, Lamp and Speaker. The RFID reader for signal detection is embedded in each Table and the detected information is send back to the Main Server through a wireless network. Each set of cups, dishes and miniatures have a RFID tags containing the ordered food related indicators and this data set would be used for constructing context-awareness. In case of passive RFID system, it does not need to be equipped with any battery.

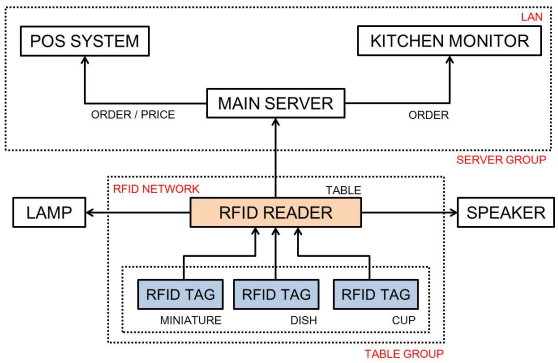

Fig. 1. Block Diagram Representing LAMF's Hardware Structure

C. LAMF system's internal process

LAMF operation is based on the context information gained through RFID tag detection occurred at each table. The process is progressed through ordering, lighting control, and payment processing as an ordinary process at restaurants. Fig. 2 shows LAMF system's flow chart.

The first step begins with the communication between the Miniatures representing specific food items and the Table through RFID system. When a user place the RFID tag attached food miniatures that he or she wants to order on the Table, RFID reader detects them and then informs the detection instance with a beep sound. Main Server receives this information and transfers it to the Monitor in the kitchen and to the Counter. If the user place an additional order, the whole flow goes back to previous steps and if not, the ordering process is finished.

Regarding lighting control, when the ordered cuisine is being served, both color and brightness of the table lighting are changed based on the type of foods identified through the RFID tag detection of cups and dishes. The brightness and color of the lighting is controlled by the types of drinking or meals being served for the very specific table. For example, if a glass filled with alcohol is detected by the RFID system, the system assumes a drinking situation and dimmed down the light. On the other hand, if there is a cup for colorless beverage like water on the table, the lighting would be changed to be brighter. After regulating brightness for mood control, the lighting color is determined by the types of foods for making them look more appetizing.

The final step is to assist the payment. This process is operated through Main Server having order information. If the RFID tags for the payment are detected, the server adds them up and sends it to the Counter. At this stage, the employee of restaurant notices that customers are needed to pay for their food. This procedure can help to reduce the manual work for restaurant management. Lastly, the customers pays the bill and the system gets back to its initial state.

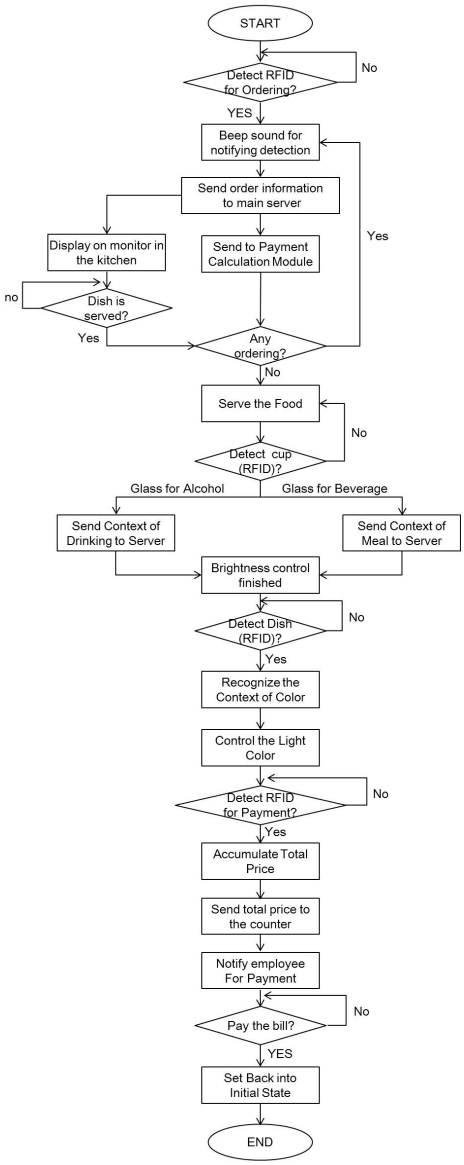

Fig. 2. LAMF's System Flow-chart

III. SYETEM IMPLEMENTATION

We developed the prototype of LAMF system and through this embodiment of the conceptual system idea, we focused on the operation of three different use cases. To implement these parts, several hardware and software components were developed.

A. Hardware components of LAMF implementation

In case of hardware prototyping for the LAMF systems, the main components are RFID and lighting control modules. For the RFID part, we decided to use passive type RFID system which is operable with 13.56MHz frequency. A RFID reader attached to each Table while RFID tags are attached to the bottoms of cups, dishes and miniatures. From these, RFID signals can be detected and send to the Main Server. As for lighting control system, a small footprint breadboard equipped with high luminance capable RGB LED bulb was chosen. ARDUINO board is also selected as an I/O interface for the lighting system operation.

Fig. 3. RFID tag and reader for Table object identification

B. Software components of LAMF implementation

As for software design and implementation, we developed both server side and client side codes using Microsoft Foundation Class (MFC) and ARDUINO development toolkit. Both server side and client side software modules are connected to each other via serial communication module.

IV. CONCLUSION

We developed LAMF system, a special type of RFID based context aware food ordering and lighting control system installable at restaurants. With this system, when RFID tag mediated food order entry is detected by the Table attached RFID reader, the data is sent to the server so that the order is completed without manual processes. The adjustment for both color and brightness of the table lamp is performed according to the ordered food and beverage types. This system helps to simplify the whole process of labor intensive food serving and payment processing discovered commonly at restaurants. If this LAMF system developed for increased automation and efficiency could be applied to restaurants, a significant level of manual tasks can be automatized and simplified. Plus, this would help to create a comfortable and cozy dining atmosphere. To develop LAMF, a smart restaurant support system into a more advanced level, sophisticated case specific scenarios especially for lighting control should be further explored in the future.

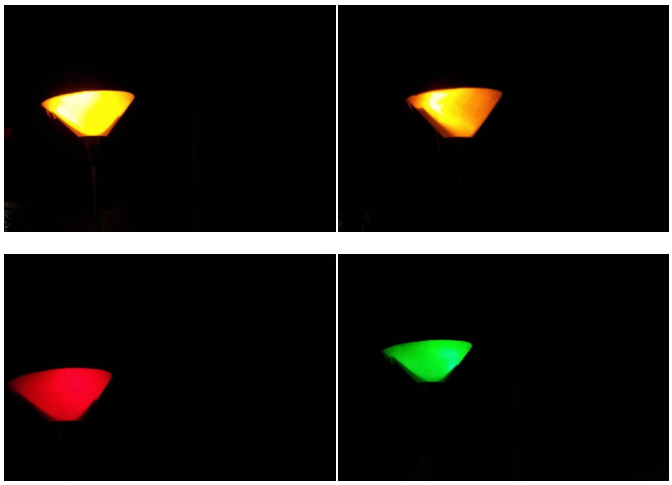

Fig. 4. Lighting color controls coordinated through serial communication

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