



New Augmented Reality (AR) Media for Food Safety Perception

Wichien Rerkpatanakit^{1*}, Tanapat Rerngjakrabhet¹ and Charkrawut Mayuret¹

¹Information Technology and Knowledge Management, National Food Institute (NFI),
Bangplad, Bangkok 10700, Thailand

*E-mail: Wichien@nfi.or.th

Abstract

The objectives of this study are to create awareness and knowledge about food safety, create awareness of risk factors that can lead to illness or injury due to food and food products to consumers, create knowledge for consumers to prevent and reduce the impact on food and food products which are safe from chemical pathogens and others and to be a channel for dissemination of researches in the Food Safety Project of ARDA. In order to conduct this research study, there are 5 steps of activities which are collecting knowledge and research related to Food Safety, develop an application for Smart phone to support AR technology (Augmented Reality), develop a system maintenance of the database (Back Office) to support AR scans or appropriate technology and import data on food safety, food safety, test and publish the application and promote the application. As the results of the research, an application Food Safety AR is a presentation of information about food safety through Augmented Reality (AR) Technology by using a Smartphone(both iOS and android) to scan relevant image that have been defined to present information in various ways which include 105 Infographics and 10 VDO animations. Yet, another result is Information about the location of the safe restaurants which received the Q-mark from the National Bureau of Agricultural Commodity and Food Standards (ACFS) and Clean Food Good Taste GOLD from the Department of Health.

Keywords: Food Safety, Augmented Reality (AR), Smartphone Application

Received: June 08, 2020

Revised: June 17, 2020

Accepted: June 29, 2020

1. Introduction

1.1 Food Safety

Food Safety is the important issue to make sure that food and agricultural products that are consumed by human are safe without characteristics that are not pure food under the law on food and according to other relevant laws for consumers are safe from food hazards, which are Biological hazards, Chemical hazards and Physical hazards. [1]

The major cause of disease by many pathogens and contaminants is life threatening. Important principles in choosing food, in addition to food flavors, must be considered and considered in conjunction with nutrition, quality, and cleanliness and free of contaminants.

Consumption of food to get clean, safe, nutritious food and free from contaminants it is necessary to have a system to monitor and control the quality of food safety in all processes. Therefore, in order for people to be able to provide clean and safe food to consume, the relevant departments need to have a system to monitor and control the quality of food safety. And conduct public relations for the general public to receive information and access to clean and safe food consumption.

However, food supply chain requires international standards to which are Prerequisite Programs and Retail Standards. Prerequisite Programs [2] are

1. Hazard Analysis Critical Control Point (HACCP)

2. Quality Management Systems (QMS): ISO 9001

3. Food Safety Management Systems (FSMS): ISO 22000

4. Laboratory Management System: ISO/IEC 17025:2005

Retail standards may be

1. British Retail Consortium

2. The Safe Quality Food (SQF)

3. International Featured Standard (IFS)

4. Food Safety System Certification (FSSC 22000)

5. Global GAP

In Thailand, there are many agencies related to food safety such as

1. National Bureau of Agricultural Commodity and Food Standard (ACFS)

2. Food and Drugs Administration (Thailand) (FDA)

3. Agricultural Research Development Agency (Public Organization) (ARDA)

4. National Food Institute (NFI)

Nowadays, clean and food safety is something that consumers are aware of and also pay more attention to. Due to the current health love that has played a role with every daily life makes consumers choose to find good and safe for life.

Talking about technology, “The eight essential emerging technologies for executives” [3] which were:

1. Internet of Things (IoT)
2. Robots
3. Drone
4. 3D printing
5. Artificial Intelligence (AI)
6. Block chain
7. Virtual Reality (VR)
8. Augmented Reality (AR)

These modern food safety technology tools can do more than just increasing yield and effectiveness and reducing cost. We believe they could increase the consumer’s awareness. It could also be used as a modern technology tool to increase the better health for all consumers.

This research will collaborate with ARDA, Bangkok Metropolitan, Department of Health (FDA) and ACFS in the use of AR as a medium to distribute food safety information to consumers.

2. Materials and Experiment

2.1 Augmented Reality Technology for Food Safety

2.2.1 Augmented Reality Technology

Augmented (or enhanced or supplemented) reality (AR) is a technology that adds an extra layer of virtual information on top of the perception of the real world, in real-time. AR technically can be used to enhance all five senses, but it’s most common present-day use is visual. AR

has the following characteristics such as combines real and virtual information and interactive in real-time, its operates is used in a 3D-environment [4]. Augmented reality application are used on many mobile platforms in various propose to promote the products or services and can integrate with 3d animation, video, picture to disseminate news, advertising or the process in food industry. Harvard business review mention Augmented reality as a set of technologies that superimposes digital data and images on the physical world, promises to close this gap and release untapped and uniquely human capabilities. Though still in its infancy, AR is poised to enter the mainstream; according to one estimate, spending on AR technology will hit \$60 billion in 2020. AR will affect companies in every industry and many other types of organizations, from universities to social enterprises. In the coming months and years, it will transform how we learn, make decisions, and interact with the physical world. It will also change how enterprises serve customers, train employees, design and create products, and manage their value chains, and, ultimately, how they compete. AR enables a new information-delivery paradigm, which we believe will have a profound impact on how data is structured, managed, and delivered on the internet. Though the web transformed how information is collected, transmitted, and accessed, its model for data storage and delivery—pages on flat screens—has major limits: It requires people to mentally translate 2-D information for use in a 3-D world. [5]

2.2.2 Applied Augmented Reality Technology

Augmented reality is a technology that overlays digital information on objects or places in the real world for the purpose of enhancing the user experience, in designing technological adaptations in response to problems or challenges. It is not virtual reality, that is, the technology that creates a totally digital or computer created environment. Augmented reality, with its ability to combine reality and digital information, is being studied and implemented in medicine, marketing, museums, fashion Augmented reality is showing up in all sorts of places: marketing, entertainment, sightseeing, industry, fashion, and medicine. Marketing has used augmented reality to showcase new products and to engage potential buyers [5]. The advantage of using AR in business is that when applying markers on product package usually no modification is required, it is widely available for users (everyone owns a mobile device), and the retailer only covers the costs of creating the application [6]. In some client companies are using AR technology to evaluate impact; IKEA reported that activity in their AR application, which allows people to position augmented furniture around their home or apartment, increased by 35% on Sundays [7].

Research in the manufacturing applications using the AR technology is a strong and growing area. The challenge is to design and implement integrated AR-assisted manufacturing systems that could enhance the manufacturing processes, as well as product and process

development, leading to shorter lead-time, reduced cost and improved quality.

Research on the mixed prototyping approach, which is the heart of AR-assisted product design applications, is still preliminary because of the critical issues, such as tracking, recognition and natural 3D interaction in AR. For collaborative AR applications, there are two issues to be further improved, namely (1) seamless integration with existing tools and practices, and (2) enhancing practice through supporting remote and co-located activities that would otherwise be impossible. [9].

AR is already redefining instruction, training, and coaching. These critical functions, which improve workforce productivity, are inherently costly and labor-intensive and often deliver uneven results. Written instructions for assembly tasks, for instance, are frequently hard and time-consuming to follow. Standard instructional videos aren't interactive and can't adapt to individual learning needs. In-person training is expensive and requires students and teachers to meet at a common site, sometimes repeatedly. And if the equipment about which students are being taught isn't available, they may need extra training to transfer what they've learned to a real world context. [10] In food industry training use of augmented reality for training to increase compliance of employee knowledge in regards to safe handling of foods. [11] Furthermore, the design and testing of an AR solution created to enhance the safety of

employees when carrying out maintenance tasks on a food processing machine. The machine which was analyzed is a hot-break juice extractor used to obtain juice from fruits and vegetables by separating out seeds and peel. [12]

2.2.3 Augmented Reality Technology in Food Safety Research

In case of Augmented reality in research work of food safety may have similarity to use as show case of research which has been published, but to revised as new presentation in the form of info graphic and animation to persuade the consumer or reader to interest by enhance of display on application in the mobile phone or tablet and using augmented reality technique to display animations and pictures which link up from the cloud system. Using the advantage of AR technology to display animation and describe detail of food hazard. [The ultimate goal to educate consumer by using technology to understand of food hazard and contamination and be aware before the consumer make decision to buy the food product].

AR support proved to be more suitable for difficult tasks than the paper manual, whereas for easier tasks AR support did not appear to be significantly more advantageous. The use of AR

technology shows wide-ranging possibilities. [13] Research in food safety advantage is to integrate database, new publishing from the past in food safety issue to renew as new form of presentation and have various type of information for everyone from consumer to researcher in usability aspect turning the difficulty of research papers to pictures.

2.2 Methodology

2.2.3 Content Analysis

Content Analysis is used in this “experimental design research”. Researchers have collected and analyzed data from Lab-results of National Food Institute (NFI) during the past 4-5 years. The results, then, used for smartphones application development, infographics and videos for ease of use of target users according to the objectives of the research. However data were categorized in 4 types of taxonomy as

1. Livestock products
2. Fishery products
3. Fruit and vegetables products
4. Cereal products

2.3 Experimental Design

The experimental design was demonstrated in figure 1, as following steps.

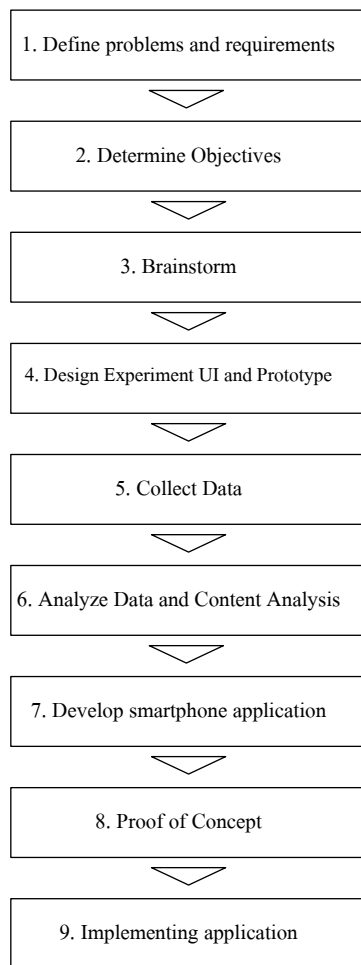


Figure 1 Experimental Design

2.3.1 Define Problems and Requirements

Problems and requirements were gathered including the technology that might to bring in to find the easy way to disseminate for target group.

2.3.2 Determine Objectives

Objectives were elaborated.

2.3.3 Brainstorm

Researchers, consumers, target group and stakeholders discussed the requirements and possibility of the research.

2.3.4 Design Experiment UI and Prototype

In designing experiment UI and Prototype have shown in context diagram in Figure 2 and details of UI and functions were demonstrated look & feel in Figure 3-4.

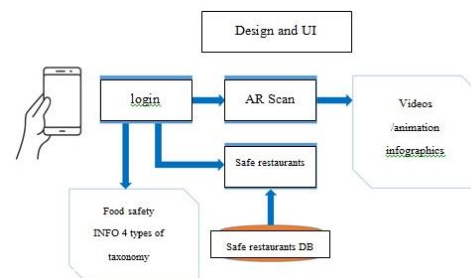


Figure 2 Design and UI (1)



Figure 3 Design and UI (2)



Figure 4 Design and UI (3)

2.3.5 Collect Data

Data from various agencies were collected including testing results in food products from NFI, details of more than 100 safe restaurants who registered with ACFS, Bangkok Metropolitan and Department of Health. There were other data and information were collected in which they could be useful for consumers and other people such as ARDA's database and information related food safety, laws and regulation and lots more which aim to support farmers, producers and consumers all along the supply chain of food from NFI.

2.3.6 Analyze Data and Content Analysis

In this stage, data and information were analyzed including "content analysis" to disseminate in form of infographics, image object (for AR Analysis), and video. Analyzing safe restaurants data and transformed into GPS-form to locate them in the smartphone application.

2.3.7 Develop Smartphone Application

This is the stage of programming for smartphone application for both android and iOS.

2.3.8 Proof of Concept

Program testing and implementation and data transform onto CLOUD. Receiving comments and feedback from stakeholders, programmers improved the application.

2.3.9 Implementing Application

This was the implementation and launching the smartphone application for both android and iOS.

3. Results and Discussion

"FOOD SAFETY AR" is an application on smartphones, as the results of this applied research, with AR technology on both iOS and android system which displays related food safety information, by scanning the packaging or documents, application will give all desired information for consumers.

Main functions of the application:

1. AR Scan with smartphone camera
2. Displays food safety information including residue, contaminant and pathogen, and risk in 4 categories related with pictures and infographics:

- 2.1 Livestock products
- 2.2 Fishery products
- 2.3 Fruit and vegetables products
- 2.4 Cereal products

3. Details of more than 100 safe restaurants with GPS

4. Search function

There are also providing important information for researchers, consumers and all people who are interested in or aware of food safety concerns. The application will link to current ARDA's researches in which researchers may take them as reference for future research. The other useful link is connected to NFI Food Intelligence web site. There are lots of information related food safety, laws and regulation and lots more which aim to support farmers, producers and consumers all along the supply chain of food.

In collaborate with ACFS; Bangkok Metropolitan and Department of Health (Ministry of Health), there are list of more than 100-safe restaurants who registered with ACFS, Bangkok Metropolitan and Department of Health in which they are positioned in area using GPS. Consumers can find safe restaurant they trust and directly find their ways to the restaurants in an easy way. The display result of safe restaurant was demonstrated in figure 5.

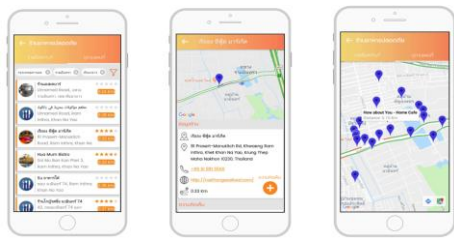


Figure 5 Display of Safe Restaurants

There are many databases set up in the “Food Safety AR” in order to make the application real time and make them accurate for using GPS.

However, since this is the applied research, there will be a lot more work and data to be put into to make it for real life used. We promoted the application to the audience by using following leaflet for AR Scanning , promoting brochure were demonstrated in Figure 6-8.



Figure 6 Sample of Leaflet for AR Scan



Figure 7 Promoting Brochure for the Application



Figure 8 Showing Animation After the AR Scan

4. Conclusion

Application on smartphones knowledge collection, as the results of this research, with AR technology on both iOS and android system which display the related food safety information, by scanning the packaging or documents, application will give all desired information for consumers. It consists of 105 food safety infographics and 10 VDO animations. The list of about 100-safe restaurants and appropriated GPS from the ACFS and Clean Food Good Taste Project form Bangkok Metropolitan and Department of Health will be listed on smartphones for consumers who concern on safe restaurants. Consumers who install this application will find out that learning information on food safety is easier than traditional methods. Their risk in touch with food hazard will be less. We meet the objectives of consumer awareness for both the research contents and risk factors to reduce the illness and impact from food-borne diseases and food contaminate from chemical pathogen and others. The advantage of this applied research help researcher to gain more than the repository in library. However, this applied research can lead us to innovative thinking about using other new technology which might be BLOCK CHAIN, 3D Printing and HOLOGRAM to benefit to FOOD SUPPLY CHAIN in many areas such as Food Safety Awareness, Food Traceability [14] and Food Production and green environment and Marketing.

Impact of this experimental research could be evaluated from number of application download, number of “click” in each section and number of AR using of this application.

5. References

- [1] Morris Potter. *Food consumption and disease risk Consumer pathogen interactions*. Woodhead Publishing Limited. 2016: 9-23, 55-70.
- [2] Alexandru Mihai Grumezescu and Alina Maria Holban. *Food Safety and Preservation Modern Biological Approach to Improving Consumer Health*. Academic Press: 4.
- [3] Consultancy.uk. The eight essential emerging technologies for executives, [Online]. Available: www.consultancy.uk/news/12960/the-eight-essential-emerging-technologies-for-executives. 2017. [Retrieved 3 January 2017].
- [4] Leanne W.S. Loijens. *Augmented reality for food marketers and consumers*. Wageningen Academic Publishers the Netherlands. 2017: 14.
- [5] Donna R. Berryman. *Augmented Reality: A review*. Medical Reference Services Quarterly. Published online: 04 May 2012.
- [6] Leanne W.S. Loijens. *Augmented reality for food marketers and consumers*. Wageningen Academic Publishers the Netherlands. 2017: 80

- [7] Tony Liao. Augmented or admented reality? The influence of marketing on augmented reality technologies. *Information, Communication & Society*. 2015: 18:3, 310-326. DOI: 10.1080/1369118X.2014.989252.
- [8] Michael E.Porter and James E. Heppelmann. *Why Every Organization Needs an Augmented Reality Strategy*. Harvard Business Review's ten must reads on AI, analytics, and the new machine age. 2019: 53-54.
- [9] S. K. Ong, M. L. Yuan & A. Y. C. Nee. Augmented reality applications in manufacturing: a survey. *International Journal of Production Research*. 2008: 46:10. 2707-2742, DOI: 10.1080/00207540601064773.
- [10] Michael E.Porter and James E. Heppelmann. *Why Every Organization Needs an Augmented Reality Strategy*. Harvard Business Review's ten must reads on AI, analytics, and the new machine age. 2019: 59.
- [11] Dennis E. Beck, Philip G. Crandall, Corliss A. o'Brayan&Jessica. *An augmented reality solution*. Journal of Foodservice Business Research. Volume 19. 2016. issue 4.
- [12] Vignali Giuseppe, Bertolini Massimo, Bottani Eleonora, Di Donato Luciano, Ferraro Alessandra, Log Francesco. *International Journal of Food Engineering*. Feb 2018. Vol. 14 Issue 2. p1-1. 1p.
- [13] Morten Fjeld. *Introduction: Augmented Reality-Usability and Collaborative Aspects*. International Journal of Human-Computer Interaction. 2003: 16:3, 387-393. DOI: 10.1207/S15327590IJHC1603_1.
- [14] Frost & Sullivan. *Food Safety in APAC Technology To Create Transparency and Traceability*. Asia Pacific FOOD Industry. April/May 2019: 24-39.