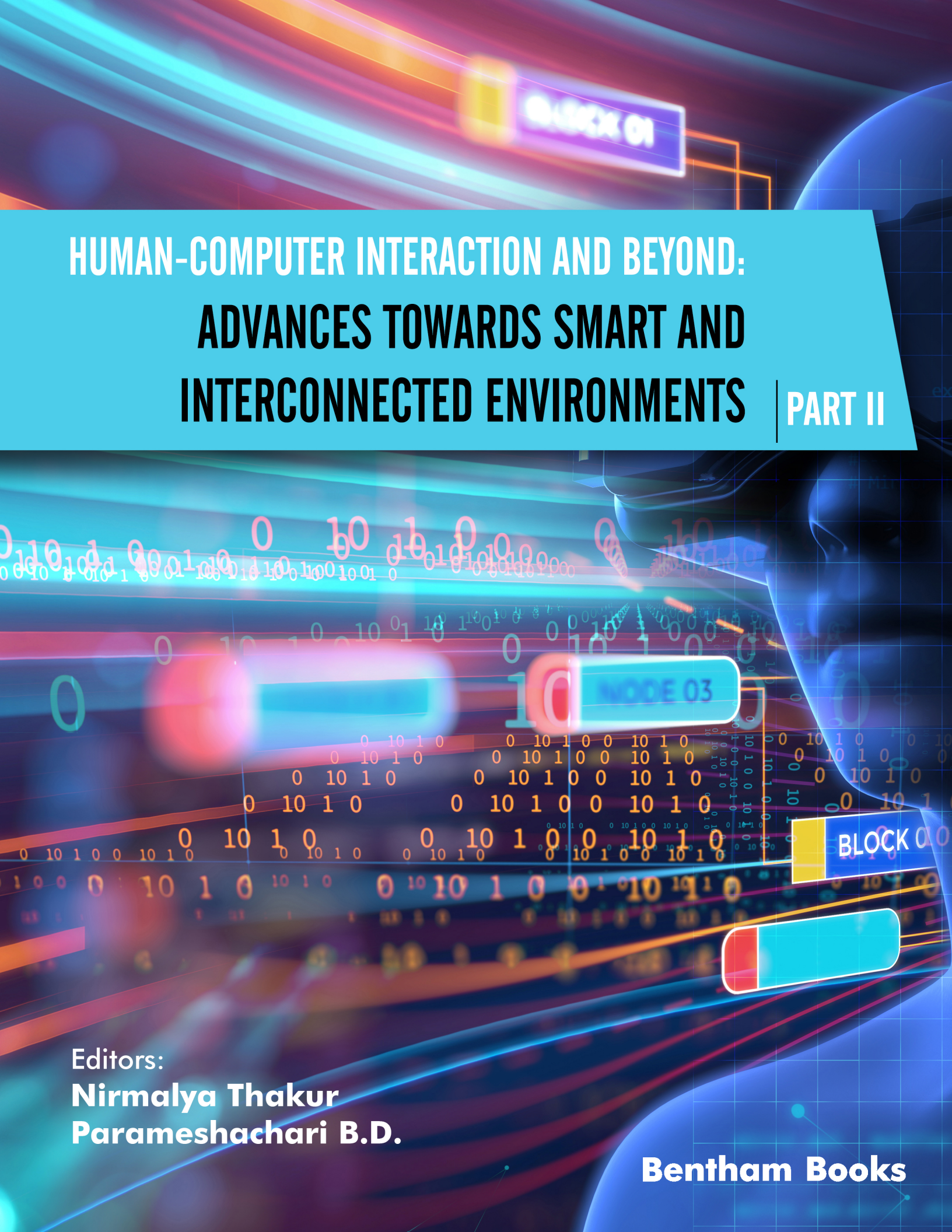
HUMAN-COMPUTER INTERACTION AND BEYOND: ADVANCES TOWARDS SMART AND INTERCONNECTED ENVIRONMENTS | PART II



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Human-Computer Interaction and Beyond: Advances Towards Smart and Interconnected Environments

Part II

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Human-Computer Interaction and Beyond:
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PREFACE

In this age of rapidly advancing technology, the future of living and functional environments would involve humans interacting, coordinating, and collaborating with computers, machines, robots, and various technology-laden systems in a multitude of ways. Examples of such smart and interconnected environments include Smart Homes, Smart Industries, Smart Workplaces, Smart Buildings, and Smart Cities, just to name a few. This is the second of the two volumes of the edited books in this series that presents discoveries, innovative ideas, concepts, theoretical findings, practical solutions, improvements, and novel applications in Human-Computer Interaction (HCI) aimed at developing trust, user acceptance, augmenting user performance, improving quality of life, and fostering human-technology partnerships in the future of technology-laden living and functional environments.

The topics covered in these books include the following:

- Applications of HCI for Smart Homes, Smart Cities, and Smart Vehicles
- Design of Technology for special user groups – elderly, disabled, *etc*.
- Prototypes of Interactive Systems with a focus on Human-Centered Design
- Applications of Artificial Intelligence, Machine Learning and Data Mining in HCI
- Computer Vision, Image Recognition and their applications in HCI
- Novel works in mobile or web development related to HCI for Smart Environments
- Applications of HCI in healthcare, education, entertainment, and games
- Applications of HCI and related technologies focusing on COVID-19

The current part of this book, Part II, presents a unique and diverse collection of the global advancements in HCI in the above-mentioned application domains. It consists of chapters authored by experts and scientists in the field of HCI and its interrelated disciplines from 9 different countries – Albania, China, India, Indonesia, Nigeria, Pakistan, Spain, the United Kingdom, and the United States. This book is aimed at scientists, researchers, and developers in academia and in the industry who wish to learn, design, implement, and apply the emerging technologies, concepts, and applications from the field of Human-Computer Interaction in different application domains, with a specific focus on the future of technology-laden living and functional environments. Each chapter has an abstract and keywords followed by the introduction, methodologies, and other sections. Readers can determine their interest level in any chapter quickly, based on the keywords and the abstract.

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CHAPTER 1

Disaster Management and HCI: A Critical Review of Current Research and Future Directions

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Abstract: The increasing frequency of disasters in the past few decades have threatened individual life and situation. Therefore, there is a growing research interest in the development and practice of disaster management systems. Disaster management systems help understand and support disaster relief, preparation, recovery, rehabilitation, risk, and vulnerability reduction to assist professionals from diverse backgrounds. These professionals can range from medical personnel, government staff, firefighters, military personnel, emergency call center operatives, and volunteers. When a disaster occurs, it becomes challenging and essential for these professionals to manage and coordinate the available resources. Thus, efficient communication and the availability of information are crucial. An effective system with an adequate HCI to assist these first responders in coordinating tasks can save time and individual life, which might not be possible without a well-defined user interface for interaction. HCI plays an essential role in supporting disaster response scenarios through disaster management systems. Though there is a rising number of researches in this area, it still lacks a complete HCI overview for disaster management systems. Hence, this chapter examines and analyzes research on the concept of human-computer interaction (HCI) in the disaster management context. It provides an overview of HCI and disaster management publications between 2009 and 2019 by presenting the current practices and identifying the lapses in how research is conducted and recommendations for opportunities in future approaches.

Keywords: Crisis management, Damage detection, Disaster, Disaster management, Disaster preparedness, Disaster recovery, Disaster relief, Disaster response, Earthquakes, Emergency, Emergency management, Emergency services, Fires, Hazards, HCI, Interaction, Natural disasters, Review, Risk assessment, Risk management.

INTRODUCTION

A human-made or natural disaster hits the globe each year, affecting and killing

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thousands, destroying properties and infrastructure, deteriorating the environment, and displacing people [1] United Nations International Strategy for Disaster Risk Reduction for Disaster Risk Reduction (UNISDR) defines a disaster as "*A serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of the affected people to cope using its own resources*" [2]. Disaster can be classified into three different categories, *i.e.*, Natural (earthquakes, tsunamis, volcanic, landslides, floods, drought, tornadoes), Man-made (fire, leakage, toxic release, structure collapse, explosion), and Hybrid (flood ravage community built in a flood plain, subsequent disaster (deforestation leading to landslides)) [3]. These disasters are random, unpredictable, can dynamically change the environment, and have limited access to the resources in impacted areas [4]. Precise planning and availability of resources play an essential role in preparing for disasters. Therefore, information technology and equipment will significantly enhance the capability before, during, and after the disaster response [5].

Human-Computer Interaction (HCI) can be used across diverse areas (*e.g.*, engineering, ergonomics, design, visualization) that deal with the design, evaluation, and implementation of methods an individual can use to interact with computing systems [6]. It involves the use of input-output technology in communicating with machines for perception and cognition [7]. Furthermore, with the growing use of multimedia applications, the importance of HCI continues to increase [8]. Currently, HCI research focuses on engineering, designing, collaboration, training, social issues, including perception, cognition, human intelligence, and interaction with any information using any device [9, 10].

The recent rise in disaster and emergency events has increased the adoption of innovative technology to exchange information and provide aid to responders and casualties [11]. During various catastrophic occurrences, including the Three Mile nuclear meltdown, firefighter deaths during 9/11, Bhopal, there were incidents of human decision-making failures by operators due to situational awareness failures of the systems [12 - 14]. HCI for disaster response can be used to collect, process, communicate, train users, support collaboration, and increase an individual's situational awareness and better decision making [15, 16].

The use of information technology for HCI during disasters and emergencies should be designed to effectively utilize the potential and provide trustworthy and efficient assistance in these situations. Furthermore, HCI plays an essential role in automating the steps in the detailed evaluation, planning, and decision-making process to maximize the disaster response effectiveness and decrease the chance of human error.

In this review chapter, we present a systematic review of the use of HCI in disaster management. This chapter aims to analyze and organize HCI and disaster management literature across a decade (2009-2019), present the current practices, identify the lapses, and provide recommendations for future research areas.

RESEARCH METHODS

This review study adopted a three-stage research design. (1) A paper retrieval process related to disaster management and its application to HCI was conducted. (2) All retrieved papers were then investigated based on the type of HCI components and the application areas with disasters. (3) Results were summarized. Future directions are proposed on how HCI can be effectively used in disaster management areas.

Paper Retrieval

This systematic literature review investigates how the HCI has been used in the field of disaster management. We review the papers published from 2009 to 2019 and only include journal articles and conference proceedings, considering their relatively high impact and high citations. Web of Science [17] and Scopus [18] were used as the search database. The keyword with search rule used for the review process was disaster management system or risk management or disasters or disaster prevention or emergency management or decision making or emergency services or risk assessment or natural disasters or floods or earthquakes or hazards or emergency response or climate change or disaster response or crisis management or risk analysis or flood control or environmental management or fires or disaster recovery or storms or damage detection or early warning system or emergency or hurricanes or landslides or disaster risk reductions or disaster preparedness or accident prevention or tsunamis or disaster relief or disaster situations or disaster information or situation awareness or emergency or disaster mitigation [19, 20]. All the publications for review were in the English language. They contained the above keywords in the title or abstract or keywords. Fig. (**1**) presents the total number of papers retrieved from 2009 - 2019 using Scopus and Web of Science. A manual screening process was used to select the articles that fulfilled the aim of this review study. A total of 136 publications was identified for processing, and the associated overview of selected papers is shown in Fig. (**2**).

Data Analysis

The selected publications using the manual screening were analyzed using codes shown below. The codes used in this study for analysis are adapted from similar

CHAPTER 2

Usability Based Rating Scale (UBRS) for Evaluation of Mobile Health (mHealth) Applications

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Abstract: Mobile Health (mHealth) applications provide information on public health care supported by mobile devices, including patient monitoring devices and other wireless devices. There is no quality assessment tool for the rating of mHealth applications based on important usability parameters. The primary objective of this chapter is to present a reliable, multipurpose, comprehensive scale for classifying and rating the quality of mHealth applications. The newly defined rating scale is primarily based on the usability parameters extracted from ISO standards, usability guidelines, and empirical study of literature. Initially, the usability of existing mHealth applications is evaluated, and their usability barriers are explored. In this study, the participants were divided into three equal groups, and each group was assigned three mHealth applications to perform a predefined set of tasks. The applications were evaluated by using existing five-star rating scale criteria. The user's study reported mismatched behavior where task performance and efficiency were not aligned with the application's rating criteria. In this chapter, the taxonomy of usability parameters is defined and distributed in five different classes. A questionnaire for rating mHealth applications was also designed, and an overall user rating was calculated by assigning weight to each question. Other three groups were involved in a second session to evaluate different mHealth applications using the newly developed usability-based rating scale (UBRS). It was found that UBRS was compatible with user effectiveness, efficiency, and satisfaction.

Keywords: Design, eHealth, HCI, Health applications, Interaction design, Interfaces, Mobile applications, mHealth, Rating criteria, Rating scale, Usability, Usability barriers, Usability experience, Usability framework, Usability guidelines, Usability Metrics, Usability parameters, Usability questionnaire, Usability taxonomy, User experience.

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INTRODUCTION

In Human-Computer interaction (HCI), the analysis of user's activities relies on their context, where affect-aware systems have the potential to create smart living space for better user interactions [1]. Mobile health applications are used to provide health information and help in the diagnosis of health-related issues. According to the Global Observatory eHealth (GOe), mobile health applications provide information for public health care supported by mobile devices, including patient monitoring devices and other wireless devices [2]. It is estimated that the number of remotely connected patients will increase with a compound annual growth rate (CAGR) of 47.9 percent to reach 50.2 million by 2021 [3]. The top five features that patients demand in a mHealth application are given below [4]:

i. Access to medical records
ii. Record of daily activity/exercise
iii. Health wellbeing tips
iv. The capacity to book, change, or drop meetings with doctors
v. The capacity to demand medicine refills electronically

Many mHealth applications are designed without consideration of the end user's requirements [5 - 7]. Many mHealth applications are complex to use and do not motivate end-users to use beneficial features [8, 9] continuously. Most developers focus on the technical aspects of mHealth applications and consider quality functions like navigation, content, appearance, multimedia, structure/design, and uniqueness. Kim, Eng at al. in 1999 recognized 167 different variables involved in the usability of health-related websites, which were further categorized into 13 groups (*e.g.,* aesthetics, ease of use, and design) [10]. The results suggested that many authors agreed on defining a key criterion for evaluating health-related websites or applications. Initially, the rating methods for websites were used for mobile applications, but later on, their customized rating systems were introduced due to the divergent nature of mobile applications. Hoehle *et al.,* in 2016, proposed a usability rating system for mobile applications based on leveraging Microsoft's mobile usability guidelines [11]. It is not only the diversity of application platforms (represented by development tools, execution services, data services, operating systems, and cloud services) that affects the usability but also the domain of application and their users that count for usability measures. A rating scale is required in the mHealth field augmented with usability parameters, covering all design aspects useful for the diversity of application platforms. At present still, there is no quality assessment tool for mobile applications beyond 'Star Ratings.' In a study conducted by Handel, M. J. in 2011, thirty-five mHealth applications were evaluated based on user rating against reliability, quality, the

scope of information, ease of use, and aesthetics [12]. The evaluation criteria used in this study for mHealth applications were complex and limited for a specific domain. The applications were evaluated against only three usability parameters, *e.g.,* the scope of information, ease of use, and aesthetics.

Khoja *et al.* in 2013 [13] explained the evaluation criteria in the form of a matrix that was divided into seven themes, further divided into four groups of an application's life cycle, *i.e.*, development, implementation, sustained operation, and integration. Although the matrix described the criteria for rating, the quality of applications, the complex type of evaluation criteria is difficult to apply in the routine usability evaluation. However, the matrix omitted the criterion for evaluating the visual aesthetics of the application. For assessing the accuracy of health-related information, there are no specific usability criteria defined.

Willems S. J. *et al.* in 2021 used the evaluation criteria for the usability, user's attitude, positive and negative experiences towards the Patient Journey application [14]. For usability, the System Usability Scale (SUS) comprised ten usability questions with a 5-point Likert scale ranging from strongly disagree to agree strongly. For the attitude, they had used the eHealth impact questionnaire with three subscales, *i.e.*, 1) confidence and identification, 2) information and presentation 3) understanding and motivation.

RESEARCH OBJECTIVES

This research aims to develop a reliable, multipurpose, comprehensive scale for classifying and rating the quality of mobile health applications. The rating scale will be primarily based on the ISO standards of usability (ISO: 9241-11 based on effectiveness, efficiency, and satisfaction and ISO: 9126-1, composed of functionality, reliability, usability, efficiency, maintainability, and portability [15, 16]).

More specifically, we will evaluate the following two hypotheses:

RQ1: Whether newly developed usability-based rating scale (UBRS) is more effective for evaluating mHealth applications?

RQ2: Whether a newly developed rating scale is compatible with user effectiveness and efficiency?

This research intends to introduce a new comprehensive rating scale that should be easy to understand and used without formal training. The newly developed scale will provide information about subscales, items, descriptors, and anchors. This scale will initially be used to analyze different mHealth applications and be

CHAPTER 3

Review of Social Media Technology for the Elderly

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Abstract: Social media has changed the way we interact with the world around us. Social media usage has taken the world by storm in the last few years, and the number of users has grown manifold. It has become a part of our lives, from organizing community gatherings to reconnecting with old friends. Social media has made the world a smaller place and brought generations together on a common platform. Social networks are important companions to support the elderly (those aged 60 years and above). It is important to know how this population group interacts with social media and its potential benefits and challenges. This chapter presents a systematic review of social media and its use by the elderly. It also focuses on the priorities and preferences of using particular social media platforms by the elderly. The younger population mainly uses it, but there has been a significant increase in its use by the elderly over the years. It has also been observed that the COVID-19 pandemic lockdown period has compelled many of the elderly to learn the use of social media platforms to stay connected with family and friends. Those living on their own are increasingly using social media to connect better with the world around them.

Keywords: Advantages of social media, Business, Conflict, Digital literacy, Elderly, Events, Facebook, Health issues, Online marketing, Online medical help, Online shopping, Preference of social media, Social interaction, Social networking sites, Social networking use, Social media, Senior citizens, The loneliness of elderly, Use of mobile by elderly people, WhatsApp.

INTRODUCTION

Social media has changed the way we interact with the world around us. It has become an integral part of our daily lives. Social networking has made the world smaller by bringing generations together on one shared forum, from hosting group events to reconnecting with old friends [1].

The research shows steady growth in the number of elderly people who sign up for social media platform services. This new trend is global. The ability for

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internet usage through mobile devices has certainly accelerated this phenomenon. Maintaining social relationships has been defined as a core element of aging well. With a considerable number of the elderly living alone, social media allows them to engage in meaningful social contact.

Social Media

Social media is an interactive platform that requires the use of technology that facilitates the creating and sharing of information, ideas, and other forms of expressions *via* virtual communities and networks by using computers and/or mobile phones. In the present study, we have considered Facebook [1], WhatsApp, Twitter, Instagram, and LinkedIn as the platforms and tools of social media.

Elderly

For this study, we have considered the elderly as those who are above 60 years of age. The internet has played a crucial role in helping the elderly, who stay at home. It is not that they do not like to socialize but are restricted by confining their mobility out of the house due to medical issues. In some cases, they stay alone, and in others, their family members are away - working. These situations can make the elderly feel lonely. For them, social media has become a boon to stay connected with their loved ones using WhatsApp, Facebook, and other such applications mentioned above.

These social media platforms have improved their lives as they can easily access information and help regarding medical issues, transportation, groceries, and home delivery facilities [2]. It is to be noted that credit must also go to the families and friends who have encouraged and taught the elderly to use social media platforms. These circles of the elderly and their families and friends benefit from social media to easily stay connected despite the physical distance separating them. As a result of these trends, businesses are also taking advantage to expand their networking and branding exclusively aimed at the elderly. For instance, the use of smartphones and computers allows the elderly better access to treatment and medicine. Businesses can now reach them through social media networks to deliver medicine, collect medical samples, and even set up consultations with doctors over video calls. This goes a long way to enable them to live healthier and longer. Research has shown that the demographic of 60-year-olds and over has experienced rapid growth in social media usage [3, 4]. New trends have estimated that more than 35% of people in this age group use social media. Moreover, this number is growing, and predictions show that by the end of 2020, there will be more than 50 million such users on social media platforms in India.

This chapter presents the analysis and evaluation of the impact of social media and networking sites for the elderly (aged 60 years and over) in India.

According to several recent research works [5 - 10], seniors who remain socially involved and engaged experience various physical and mental health benefits, including increased cognitive function. Social interactions keep them sharp and mentally active, helping prevent mental disorders and preserve good emotional health. Social networking sites such as Facebook, WhatsApp, Twitter, LinkedIn, and Instagram can be used to maintain social connections with friends, colleagues, and family, irrespective of geographical distances or physical impairments. This is particularly beneficial for them as it prevents their social exclusion against which they are most vulnerable.

SHIFTING PARADIGM

This chapter provides insights into the body of knowledge on how social media platforms can increase the quality of life of the elderly [11] and the popular social media platform used by the elderly respondents of this study [12]. The elderly were reluctant to use social media platforms as they appeared on the horizon one after another [13]. Perhaps, it was perceived that it is meant for the younger and technically literate younger generation only. At a younger age, the elderly did not have rudimentary computer knowledge [14] as part of their school and college education. But after watching the technology revolution in society and realizing the importance of technology, slowly, the elderly started experimenting with it [15 - 17].

As the technology evolved and became more user-friendly [18] and started impacting people's professional and personal lives [19], the elderly too learned and adapted to these changes. They proceeded to use and perform several functions using technical equipment like computers, laptops, and even smartphones. According to Thakur *et al.* [20], Interactive Virtual assistants serve as a cost-effective solution to assist elderly people in several ways. They provide social support, manage loneliness, the medium of communication, a reminder system, and even instill positive methods in their users.

Defining age can be difficult and complex due to its multi-dimensionality. Aging can be conceptualized within the context of a four-dimensional model based on biological, cognitive, social (actions), and functional, psychological areas of self [8]. The increase in the life span of human beings due to advances in health and medicine has sparked a global aging phenomenon that has resulted in an energetic older population (compared to a few decades ago), thereby questioning traditional definitions and boundaries. Typically, chronological age has been used to define the elderly, predominately for research on aging and communication, as it is easy

CHAPTER 4

Usability Evaluation of Mobile Applications in Indonesia

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Abstract: Indonesia has one of the world's fastest-growing mobile applications markets.Due to the increasing population of Indonesia and with the growing number of mobile applications in Indonesia, a user-friendly interface is important to stay in the competition . In this study, we evaluated three big mobile applications for various purposes. We conducted a separate experiment for each application. The first experiment evaluated DANA, one of the most-used e-wallet. There were seven subjects recruited with ages ranging from 35 to 53 years for the first experiment. The second experiment recruited eight subjects aged 20 to 50 years to evaluate GOJEK, the leading taxi booking, delivery, and payment application. The third experiment evaluated Blibli, one of the biggest e-commerce applications. A total of 7 subjects with ages ranging from 53 to 63 years were recruited in the third experiment. Think aloud protocol and system usability scale (SUS) questionnaire were used to evaluate the usability of the applications. From the collected data, the SUS scores were found as 65.71%, 70.63%, and 76.07% for DANA, GOJEK, and Blibli, respectively. The evaluation results showed the mobile applications we tested to be acceptable. However, the applications need to undergo further improvement in order to increase their acceptability.

Keywords: Acceptability, Blibli, DANA, Delivery, E-commerce, E-wallet, Gojek, Indonesia, Interface, Internet, Mobile market, Mobile application, Mobile device, Mobile phone, Payment application, SUS questionnaire, Taxi booking, Think-aloud, Usability, User-friendly.

INTRODUCTION

Indonesia has one of the fastest-growing markets for mobile apps worldwide. This is because people prefer using mobile phones while accessing the internet. Over the past decade, the number of mobile phone users in Indonesia has increased significantly. Up to 2019, there were approximately 170 million mobile phone

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users out of 274 million Indonesian population [1]. Mobile phones have become a common device and cannot be separated from our daily lives as their functionality has evolved greatly [2, 3]. To perform business activities, more and more Indonesians prefer to rely on mobile devices. Besides, the transition from conventional trade to electric commerce using technology promotes efficiency. E-wallets, mobile transportation, and e-commerce applications have been successful business models in Indonesia. Mobile payment encourages consumers to use mobile devices to carry out their activities, such as paying for products and services [4]. Mobile order and payment have been used as alternative methods in Indonesia. Using mobile applications is more practical than traditional methods such as paying bills directly to the counter, calling for a taxi, going to a restaurant for takeaway, and going to the shopping mall to buy clothes.

Nowadays, mobile devices are widely used by many people around the world. Many mobile applications are created to make life easier, making complex tasks more practical to accomplish. As the number of similar applications increases, the competition among the applications becomes tougher. The most important thing is the usability of the application itself. Usability is the ease of use related to applications involving suitable features that perform specific tasks in the right environment [5]. Usability is very important, whether it is before and after the development of the applications. The more friendly will be the application to be used, the more user will use it. The user interface design is very important because it ensures communication between the user and the application. A poor design will make users find more problems when operating the application.

The usability evaluation could help the developer in making a prototype based on the audience's feedback. This study conducted three different experiments to evaluate Indonesia's most used mobile applications, namely DANA, GOJEK, and Blibli.

USABILITY EVALUATION

Usability evaluation is a technique to evaluate products, system acceptance, and user performance [6] as a quality attribute that assesses the ease of use of user interfaces [7]. The selected users are chosen to represent the customers. These people are then asked to complete some tasks while the investigator observes the behaviors of the users. In a competitive market, usability is important for an application. People will leave and never use the application if it is complicated [8]. Usability is a way to ensure that the system is understood as adaptable by users with a minimum negative outcome [9]. With usability evaluation, it can be seen whether the application has been made according to users' needs and acceptance [10].

Usability Attributes

There are five attributes to be evaluated in usability, namely learnability, efficiency, memorability, errors, and satisfaction [7, 11]. The measurement can be carried out by determining the set of tasks relative to the usability attributes. In learnability, the evaluation is to see whether the system is easy to understand by the users. Based on this attribute, the users need to perform simple tasks when they encounter the design for the first time. The indicators of learnability are easy to understand, easy to look for specific information, and easy to identify the navigational mechanism [11]. We can reasonably infer these indicators from the time required to achieve user performance standards and perform the tasks correctly [12].

Efficiency is about whether the system as a whole can be used to retrieve information efficiently. This attribute measures how quickly users finish a task after learning the design. The efficiency indicators assess how much time it takes to complete tasks and how many steps are required [7]. Memorability means that the users can easily return to the system's previous state without start it all over from the beginning. It is measured by how easy it is for the user to recall their memory in doing the task after not doing it in a certain time. The indicators of memorability are ease in remembering and ease in reestablishing.

Errors should be minimized in the system, and the users can overcome errors easily. This attribute can be measured by evaluating how many errors users make, how severe they are, and how easy it is for the users to recover from their mistakes. In addition, the users should have a pleasant feeling after using the application. Satisfaction is about ease of use, clear labeling, organization of information, error corrections, content and visual appearance. Satisfaction can be further examined with respect to ease of use, information organization, terminology, labeling, visual appearance, content, error correction, best features, and worst features [7]. A past study by Raita and Oulasvirta [13] found that user expectations strongly influence the usability rating. Therefore, usability evaluation measures and analyzes usability problems and predicts how future users will use and perceive the product [13].

Think-Aloud Method

The Think-Aloud method is the most effective usability method to evaluate the user's perspective since human changes behavior as technology changes [14]. Think-Aloud simply verbalizes the user's thoughts. Even though it does not solve all problems, it includes simple, cheap, robust, flexible, and easy to learn techniques.

CHAPTER 5

Event-Based Multi-Model Classification to Assess the User Participation Levels on Twitter

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Abstract: Social network and microblogging have become prominent mediums of communication for personal and commercial prospects. Twitter outstands the race, becoming the most popular platform for sharing information. It has helped facilitate long-distance communications between people. A media person can converse with a random person from a distant location and *vice versa via* Twitter. During events like elections, Oscar awards, earthquakes, terrorist attacks, and other disasters and entertainment occasions, the crowd gathers to share opinions, debate, review, support, and participate in the virtual world. This paper has classified crowd participation in a couple of events and types of users' participation levels in multiple dimensions in the context of those events.

Keywords: Communication, Crowd participation, Crowdsource, Disasters, Earthquakes, Elections, Entertainment, Media person, Microblogging, Multi-model, Multiple dimensions, Nser participation, Online communication, Online media, Oscar awards, Participation levels, Social media, Social network, Terrorist attacks, Tweet, Twitter, Users, Virtual world.

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INTRODUCTION

A considerable quantity of population, when gathered, is pronounced to be crowded. The assembly could be a volunteer service or a live musical night. Any message spread among the group is expected to reach everyone, and then they deliver their views regarding it. It is hard to judge the crowd in the material universe that participated in the information exchange unless a preplanned survey is coordinated. When the survey is conducted on the mass audience, who are present at the same place, there is a considerable probability that people may shift their view according to external elements, and the actual feelings will remain hidden. When people assemble on a social network in the virtual world, they will not play by the rules; instead, they will exercise their right to free expression and broadcast whatever they are feeling on the inside. The crowd gathering on online social networks provides more qualitative and quantitative information that can be extracted, making crowdsourcing one of the powerful data sources for research [1 - 3].

Twitter, a 140-character microblogging platform, has become a spotlight in recent years. Twitter is a platform where anything and everything is shared with the world, such as a plane crash to a movie review that might not have even been released at large. Twitter allows users to follow each other, allowing them to visit the posted updates. Unlike other social networks like Facebook or Myspace, the relationship between the users is not necessary. Any random person can follow other random people without their permission, provided the user does not choose to keep their account privacy locked. Twitter has well-formed standard templates for the messaging called tweets; '#' before the word stands for a hashtag, which is used for the words to be highlighted or essential, '@' accompanied by the user-id indicates direct tag to the user and 'RT' refers to retweeting. Retweeting is mainly used to repost someone else's tweet on the Twitter user's wall for their followers to see.

Twitter has been recreating an essential role during mass disruptive conditions, providing informational data from the disaster location to acquire solutions from afar. It provides a comfortable medium for digital volunteers around the globe for sharing and exchanging information. In cases of emergency, the response can be instantaneous. Most of the tweets are publicly visible, and those in closed groups are accessible to group members who can make a particular tweet public. A retweet is a powerful option that allows spreading the tweet like a wildfire, leaving behind no trace of origin [4, 5], which has been termed as a valuable research space for information convergence across the net with no boundaries [6 - 8]. The paper focuses mainly on crowd participation levels during crises or disasters or public celebration events and random participation. Moreover, it

extracts the qualitative #keywords and calculates the quantitative frequencies of keywords and user participation[2], and it also classifies the user participation with both qualitative and quantitative approaches.

Introduction: This section introduces crowds and twitters in general and narrows down the paper's future aspects. Related Work: It covers the background of microblogging, the role of Twitter during calamitous situations, crowd gathering and crowd dynamics, crowdsource, and participation. Methods: It discusses scraping the Twitter data, cases, disasters, and natural calamities considered and the raw data that was used. The study covers the events, summarizes the scraped tweets, users, and keywords, explains the necessary observations, and discusses the nature of the data by plotting Gaussian Kernel Distribution. Filters and Classification: It models the data in multiple ways, taking a multidimensional approach to show the users' participation levels and the associated keywords. Result: The derived results are discussed concerning various classification techniques and the differences in them. The paper is concluded by elevating the crowd participation levels during events and random days while highlighting the future scope of work in this field.

RELATED WORK

Twitter's application programming interface (API) allows data crowing and scraping. This API, when integrated with a program code, makes the users and public tweets accessible. Here, we employed the keyword search approach to extract tweets between relevant dates pertaining to the issues we focused on. As mentioned earlier, Twitter has a standard structure for its tweets, allowing the public tweet collection to become an easy option [9]. Several studies have been performed on the design of the tweet, the parameters of the tweets, the text orientations, and the unique character significance. The behavior analysis of the user in the context of tweets is done using machine learning techniques. In the sentiment analysis research related to tweets, geographical and topological potteries are usually derived. The communication patterns between friends and followers that generate crowdsourced data have been investigated by multiple researchers. A crowdsourced data is a primary source for understanding human patterns of interactions [10].

In the context of discussions related to controversial events on Twitter, researchers have discussed the pipeline and developed blended models to rank these events based on various folds using crowdsourcing technology [11]. For instance, in this work, the data collection focused on keyword search with common keywords in English and regional language, including the associated geolocation. The paper proposed an algorithm to consider the keywords and the

CHAPTER 7

Usability Evaluation of COVID-19 Mobile Apps Using SUS

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Abstract: The whole world is going through an unprecedented crisis in the wake of the Coronavirus disease (COVID-19) outbreak resulting in lockdowns and imposing restrictions on economic activities. Governments are leveraging technology for identifying, monitoring, tracking, and containing active cases using mobile apps. Many countries have developed and deployed COVID-19 mobile apps to track patients, trace contacts of infected people, and provide services and facilities medicines to needy people. Indian government developed the "AarogyaSetu" app to track infected patients. However, the utility of these apps, their effectiveness, their usability score raises many open questions. A description of usability, usability attributes, and usability evaluation methods for such apps are presented in this chapter. The chapter also covers the results of practical experiments due to COVID-19 mobile apps from different countries and different apps developed by various states in India and shows the calculated usability score. This chapter will help the reader to understand the usability of COVID-19 mobile apps. A questionnaire collects usability attributes like efficiency, effectiveness, user satisfaction, user feedback, *etc*. In the questionnaire, usability evaluators prepared ten questions about each attribute, each question having five responses from strongly agree to strongly disagree. These responses are evaluated and used to calculate the app's usability score using the System Usability Scale (SUS) tool. Using this score will help governments and organizations identify problem areas and improve the usability score.

Keywords: Centralized apps, Contact tracing, Coronavirus, COVID-19, De-centralized apps, Empirical study, India's Aarogyasetu, Mobile applications, Questionnaire, QUIS, SUS, Track patients, Usability, Usability attributes, Usability evaluation, Usability evaluators, Usability models, Usability score, Usability scorecard, Usability standards.

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INTRODUCTION

The number of coronavirus cases worldwide is nearing 47 million, with 1,205,321 deaths [1], and public health systems in many countries are struggling to cope with the pandemic. Some countries have introduced contact-tracking applications to endorse other initiatives, like lockdowns and physical distances, to prevent the spread of the virus. The government of various countries gathering personal data on people for public health is not new. During the 2014 Ebola virus epidemic, South Korea, and African Nations did so during the 2015 MERS outbreak [2]. However, the emerging coronavirus pandemic is the first public health epidemic. Government data analysis aims to exploit new technology, big data, and algorithm-driven decision-making on a universal scale. Contact-tracking applications are where all this comes together.

BACKGROUND

Contact Tracing

Contact tracing is a crucial public health initiative of COVID-19. Contact tracing intends to break communication sequences by having individuals who have been in contact with an infected individual are aware of an elevated risk of infection and how to take measures to avoid the spread of infection to others [3]. Contact tracing requires persons to consent to regular surveillance, to be able to monitor obvious symptoms of COVID-19 immediately, and to be ready to undergo quarantine for a period of a minimum of 14 days or to be isolated if they become symptomatic [4].

Singapore used the first contact tracing application named 'Trace together' [5]. India developed AarogyaSetu [6], France developed StopCovid [7], Australia developed COVID Safe [8], Germany developed Corona-Warn [9], Italy developed Immuni [10]. Ireland developed COVID Tracker [11] to contact mobile apps used by various countries. With over a hundred million installations, India's Aarogyasetu, a requirement in several public places, is the world's most downloaded contact-tracing app. India tops in downloading the contract-tracing application, though considerably slower penetration. There are two types of contact tracing - Centralized and de-centralized. Aarogyasetu was centralized contact tracing mobile application. Table **1** shows the list of mobile apps selected for usability evaluation.

Difference Between Mobile Applications Contact Tracing and Manual Contact Tracing

When compared with manual contact tracing, mobile applications have some benefits:

- Applications do not depend on the willingness of the case to remember who they were in contact with.
- Applications can encourage cross-border contact tracing, providing interoperability is assured at the design phase.
- Applications will theoretically speed up this process by easily tracking and managing contacts.
- Applications may promote the follow-up of interactions between health authorities.

Some drawbacks of contact tracing with mobile apps when compared with the manual procedure:

- Some people are not carrying a smartphone. Some persons may become wary while installing the app.
- Even though smartphones are carrying by people, they may switch off the phone.
- Some smartphones have a compatibility problem with the software.

Table 1. Apps selected for usability evaluation.

S. No	Name of App	Country/ State	Type of App	Features of App	Play Store User Rating
1	AAROGYA SETU	India	Health and Fitness	self-assessment test, best practices, information about relevant advisories about the containment of covid19	4.4
2	Open WHO	World	Education	interactive knowledge transfer platform, transfer lifesaving knowledge, source of information for those affected by decease outbreak and health emergencies, ready for response, providing learning resources	4.3
3	CG COVID-19 E PASS	Chhattisgarh	Productivity	travel pass	3.9

CHAPTER 8

Enhancing the Human-computer Interaction through the Application of Artificial Intelligence, Machine Learning, and Data Mining

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Abstract: Machines have become an essential part of day-to-day human activities; their volume and frequency of usage have rapidly increased in every sector. These machines, especially the computer system, are well known for their speed, accuracy, repeatability, and use to execute tasks that can be harmful to humans. However, these machines lack intelligence, as they do not possess the ability to think like humans. The quest for producing machines with thinking capabilities led to artificial intelligence; thus, many efforts were channeled towards developing devices that can communicate with their surroundings, making a logical decision on what has been perceived, and then provide the proper solution to the problem. To achieve this feat, machine learning is utilized by subjecting the system to a series of training using algorithms and data mining techniques, which is similar to how humans learn from infancy till adulthood and then execute tasks based on knowledge and the experiences they have gathered growing up. While these technologies opened a creative horizon for technological development, there is a current demand for intelligent user interfaces with high usability that can sustain the mode of interaction depending on users, tasks assigned, and the environment. This chapter attempts to present an overview of how data mining can be incorporated with machine learning to produce a machine with artificial intelligence and how both can improve the intelligent user interface.

Keywords: Algorithms, Artificial intelligence, Data, Data mining, Database management, Database, Decision tree, Human-Computer Interaction, Human Intelligence, Information mining, Intelligent machine, Internal node, Knowledge mining, Machine learning, Multimedia database, Neural network, Regression, Relational database, Spatial database, The Root node.

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INTRODUCTION TO DATA MINING

In daily human activities, many data are generated and stored in different formats on various platforms. Over time, these data accumulate, and the database becomes massive and quite overwhelming. The advent of information and technology has led to an efficient data collection method, storage, and management to generate tangible details and make other decisions [1]. The database management system (DBMS) has been very useful in managing the large volume of data generated in various human sectors. This has provided a lot of information retrievals even more than humans can work [2]. As technology improves, there is a growing need to obtain information (patterns) capable of predicting the future from available past data rather than the usual information retrieval (from past data) for present use only; thus, this led to the concept of 'Data mining.' Data mining is the process of discovering and decoding information that may be in the form of patterns, associations, anomalies, *etc*., concealed in a large volume of data [1, 3]. It is an analytical tool employed in investigating a massive database to find unique trends embedded in the data sets. The obtained trends or patterns can provide relatable descriptions and, more importantly, reliable and accurate predictions.

The term data mining was coined from gold mining. This is due to similarities between looking through a big data warehouse for important information and digging through rocks for mineral resources like gold. Since gold mining involves extracting valuables (gold) from the rock and therefore, is not termed 'rock mining', data mining should have been referred to as 'knowledge mining' or 'information mining' from data. Nevertheless, the name data mining is generally accepted [2].

KNOWLEDGE DISCOVERY FROM DATABASE (KDD)

Data mining is sometimes referred to as knowledge discovery in a database (KDD). Data mining is only one step that makes knowledge discovery from the database [3]. It is a very crucial step that must be passed through to discover the knowledge embedded in data. Fig. (**1**) highlights the steps involved in KDD.

KDD is an iterative process to uncover or extract new and unknown information set from the database. The steps involved include:

i. Cleaning of Data

The database is usually voluminous and contains many redundant data that are irrelevant to the situation under analysis. It is therefore expected that only targeted or relevant data are extracted from the big database. Also, raw data are characterized by many errors and inconsistencies, often referred to as noise in the

database. These noises must be eliminated; hence, removing redundancy and noise from the database is called data cleaning.

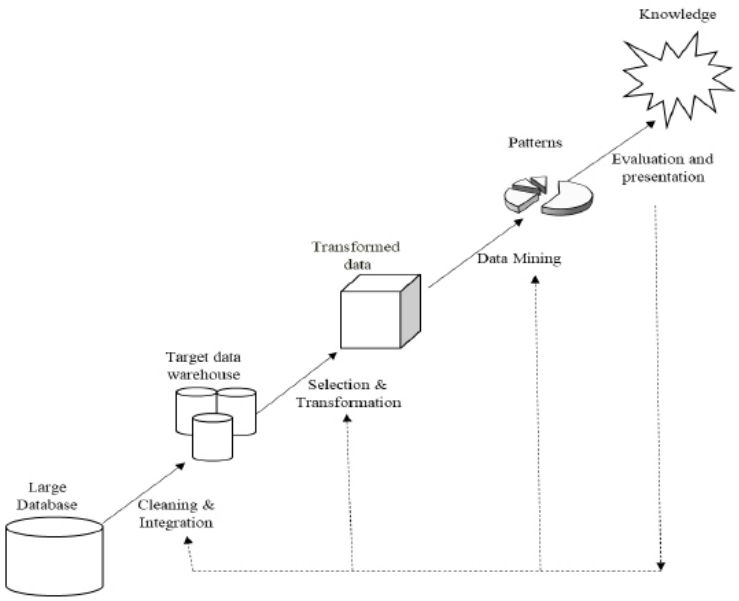

Fig. (1). Steps Involved in Knowledge Discovery in Database (KDD) [1, 3].

ii. Integration of Data

It is common to have various (different) data sources that contain data that describes or is related to the same situation or area of interest. The process of collating and combining these databases to form a comprehensively new database of relevant and noise-free data is called data integration.

iii. Selection of Data

After the collection of various target data, for further processing, it is necessary to reduce the data by selecting data that are most relevant to the task at hand from the data warehouse. This is done by performing a reduction in data dimension or selection of specific features [4]. This step helps prevent the high computation cost and remove non-relevant associations and rules pertinent to preparing the mining data.

iv. Transformation of Data

This is the conversion or consolidation of data that has been selected into formats that are suitable for mining. It can also be referred to as data consolidation.

CHAPTER 9

Applications of Human-Computer Interaction for Improving ERP Usability in Education Systems

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Abstract: Human-Computer Interaction with a portable device is the latest trend in the education system that reinvented the wheel of learning by delivering learning in a new and small package, *i.e.*, a Smartphone. New approaches and technologies have come into existence to enhance the effectiveness of teaching and learning. The current generation of learners has the flexibility to learn their subject online through devices such as iPad, mobile, and laptops. They can save their important notes online, submit their assignments, and perform numerous tasks daily. For academic purposes, Enterprise Resource Planning (ERP) saves time and reduces paperwork. It was also used to disseminate information to students for tasks such as sharing pre-post reading materials, assignments, mock tests, case study or other teaching resources. This research is based on mobile learning applications, *i.e.*, Enterprise Resource Planning (ERP), and their usage among students in education and academic staff at the college and institutions. This research aims to use ERP software and identify if it is currently being used to enhance or upgrade the level of the education system for students and check whether it supports e-learning in the institutes. The Research analysis of the ERP software is performed by collecting data across Educational institutions. The results of the research share the module-wise details of ERP usage in education.

Keywords: Academic, Business, College students, Enterprise systems , *ERP*, ERP education, ERP implementation, HEI, Implementation model, Learning ERP, *MET*, Modules, Navigation systems, Online learning, Questionnaires, Research methodology, Software, Staff, System evaluation, Usability .

INTRODUCTION

Over the past few decades, the influence of technology upon children and education has been immense. There are many applications available in Appstore; choosing the right one for your child can change how they learn different topics.

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Educational books are often tiring and boring for children while replacing them with colorful pages, and moving animations can make learning fun to the core. Online applications in education can make children more interactive and activate better engagement between parents, teachers, and children. Interaction tendency in children is enhanced by online learning [1].

Academic ERP applications have also increased parent-teacher communication. Due to both the parent and teacher's tight schedule, it is impossible to maintain rapport through physical Interaction. Since we have an Academic ERP system these days, teachers can attend to parents' queries anytime and anywhere. Unlike Higher Education Institutions (HEIs), mobile applications are available round the clock. A classroom can be set up anywhere. App-learning is not time-bounding learning; instead, it is relaxed learning. These days most online applications promote child-friendly control. Little ones can operate it without much effort. They just need to reach out for the device when they feel like learning.

The education system using Academic ERP is a new platform of Education System that efficiently manages student information and automates the process for the stakeholder. It also helps teachers, students, parents, and the administrative staff use data in an organized and well-structured manner. Since people are getting tech-savvy, nearly everyone has a laptop or Smartphone, and these days students use them for studies. Various Educational applications can teach us almost anything, anytime and from anywhere. These online educational applications proved to be a considerable asset to learning as they create a blend of prior learning and innovation [2,3].

If we are looking for educational software, which is very useful for a university or college to be well-organized in business operations [4], Academic ERP is best [5]. With the rapid development of Information Technology, ERP has been developed in the education sector [6] and used in various enterprises and organizations [7 - 10] for managing business and decision-making. In the case of application-oriented talent education [11], it is necessary to have a great understanding of ERP content, meaning, and strategy.

According to a study [3], mobile application is a continuously growing technology with meaningful use in the academic sector. Academic ERP is prestigious as a powerful weapon to grab the competitive advantages and achieve the strategic goals of Enterprises. Educational ERP has focused attention on restructuring the Education system or Management [12] and supporting the strategy development. Various academic documents about ERP educational programs have been published [4 - 12]. This paper presents practical research that is done through teaching Master of Business Application (MBA) courses through

the Academic ERP system [13,14].

ONLINE LEARNING APPLICATIONS

BYJU's

BYJU's learning online application is the world's most extensive training application for students pursuing their studies in HEI's [15]. It is noticed that 16 million students are registered on this platform for their studies. The founder of this application is Byju Raveendran, who has cleared Common Admission Test (CAT) twice with 100 percentiles. He was a person who was training graduate students on how to crack the CAT exam.

CAT is an entrance exam conducted by the Indian Institutes of Management (IIMs). Suddenly, he shifted his focus to early childhood education. He decided to create an atmosphere to promote necessary educational skills. His idea turned to BYJU's Learning Online Application, through which millions of students across the globe are benefitted. This shows the need and growth of Online Educational Applications in today's ERP [16, 17].

Wikipedia

Wikipedia is an open platform for everyone in which the online encyclopedia created was through the collaborative efforts of a community of users known as Wikipedia's. It's a free platform for anyone registering on the site and creating an I.D., updating, or upload any articles for publication. According to Alexa.com, a web tracking company owned by Amazon, Wikipedia averages more than 18 billion page views per month, making it one of the most visited websites in the world. Wikipedia is an online website that has helped many students, researchers, philosophers, Scientists, *etc*., to explore information and retrieve valuable knowledge. It is an excellent example that proved online reading has been a need for the hour by everyone [18].

The BYJUas mentioned above Learning Application, and Wikipedia online application, as mentioned above, are the best example for students opting for e-learning to enhance their knowledge.

ACADEMIC ERP SYSTEM

ERP is an information technology strategy to merge all information within an organization to create a comprehensive information infrastructure encompassing all organizational units and functions. The process requires a central database that places all administrative information into a unified format to serve as a resource in

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