VFAST Transactions on Software Engineering
https://vfast.org/journals/index.php/VTSE@ 2023, ISSN(e): 2309-3978, ISSN(p): 2411-6246
Volume 11, Number 4, October-December 2023 *pp:45-56*

User-Centric Advertisement using Software Sensors Technique

Abdul Rehman Baloch , **Kamran Taj Pathan** , **Azhar Ali Shah**

Faculty of Engineering and Technology, University of Sindh, Jamshoro, Pakistan

Keywords: *User-Centric Advertisement. Software Sensors. Context-awareness. Pervasive computing. Ubiquitous Computing.*

Journal Info:
Submitted:
September 30, 2023,
Accepted:
November 28, 2023
Published:
December 04, 2023,

Abstract

Contextual advertising plays a vital role in the Internet's economy, significantly impacting the revenue of Internet publishers. This form of advertising relies on user-centric ads displayed on websites based on the user's context during their interaction with various sites. While previous research has focused on keywords, site content, and other network applications, there is a need to expand this work to include the user's context. In this study, we examined user profile information and preferences to better target users based on their context. Smart devices can provide valuable context, including information about the user's physical environment, social connections, and internal and external context. These logical contexts, beyond just the content of web pages and search keywords, are effectively utilized for user-centric advertising. We also discuss the challenges of utilizing logical contexts available on the user's browser and profile to improve advertising results. We propose a user-centric advertising architecture and model that integrates user profile and activity context to select, generate, and present contextually relevant ads. Finally, we discuss the design aspects and a specific application, as well as outline our plans for the future.

***Correspondence author email address:** arehman.baloch@usindh.edu.pk
DOI: 10.21015/vtse.v11i4.1610

1 Introduction

The concept of ubiquitous computing was first introduced in 1991 by M. Weiser [1], is now known as pervasive computing. This concept involves a shift from information residing solely within the confines of a computer to being present all around us, seamlessly integrated into the flow of information at any time and in any place [2]. Pervasive computing aims to support everyday activities without requiring the constant attention of users. To achieve this vision, Context-Aware Applications are utilized to gather contextual information from user activities and provide relevant services to the user, with these applications operating on behalf of the user [3].

There are issues in the current application where it does not effectively target advertisements in a dynamic way that aligns with the changing user activity. Our goal is to resolve these issues by implementing contextual advertisement strategies that take into account the logical activity context of the

end-user. This includes gathering information from web-based apps about the user's age, education, gender, income/finances, personal history, likes, dislikes, interests, and lifestyle. This information will allow for targeted advertising that is tailored to specific consumer segments, ultimately aiming to assist users in achieving greater productivity.

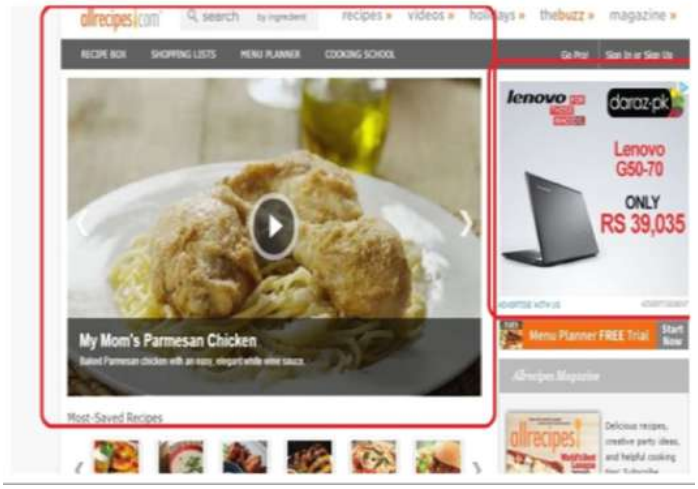

Figure 1. Food Recipes websites containing laptop advertisement

The current situation is such that applications may not always perform as expected, and user preferences can change over time [4]. The internet has connected users globally, and there is a wealth of evolving user information available. It is essential to create a net-centric environment where context-aware applications can work in a user-centric manner, gathering and utilizing user data to empower and benefit the user according to their individual needs [5].

The goal of pervasive computing is to seamlessly integrate technology into the user's environment without their active awareness. This is achieved by detecting the user's activity context through software sensors and processing inputs to determine the logical activity context, allowing for targeted advertising. The website www.allrecipes.com provides information on dishes and recipes, with ads served by the AdSense Google Server. However, the ads may not always match the website's content or user queries. In contrast, www.timeanddate.com offers a web-based

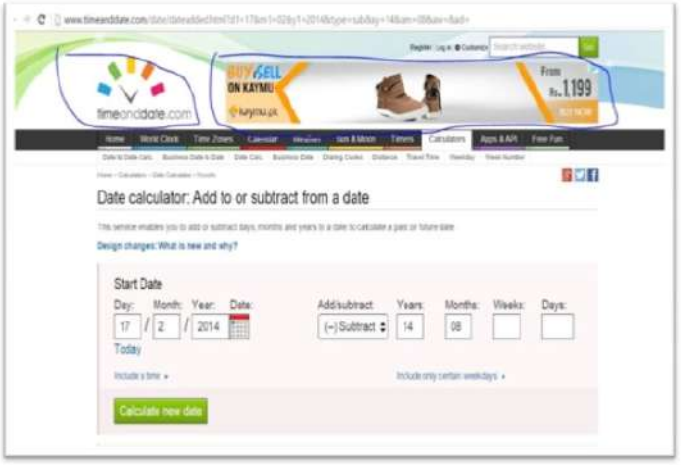

Figure 2. Date Calculator websites containing shoes advertisement

application for adding or subtracting start and end dates and times, with ads displayed based on the user's previous search history.

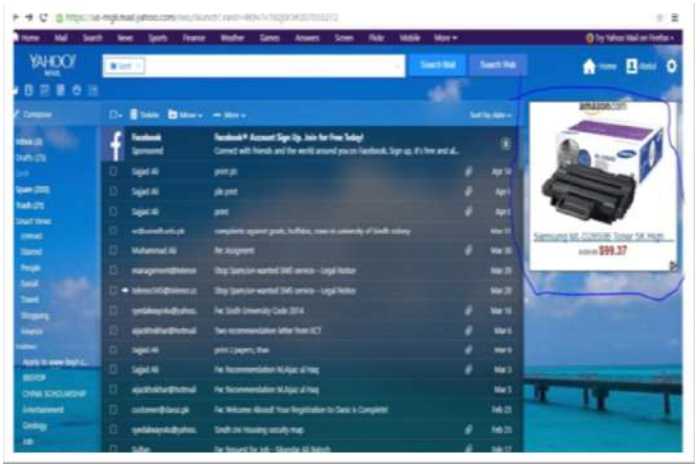

Figure 3. Date Calculator websites containing shoes advertisement

A Yahoo email shows the advertisement server repeatedly targeting the user with ads for computer printer toner, despite no evidence of current interest. The ads also appear on the user's Facebook page. The study focuses on accessing relevant information when interaction context is present, including service request time, application status, and user identity. It also defines context-aware advertising based on user profile, activity, and web page content. Context is

categorized into physical and logical contexts. Your paper's introduction is an opportunity to provide readers with the background necessary to understand your paper: the status of knowledge in your field, the question motivating your work and its significance, how you sought to answer that question (methods), and your main findings. A well-written introduction will broaden your readership by making your findings accessible to a larger audience.

Figure 4. Date Calculator websites containing shoes advertisement

Research Contributions: The research findings address the challenges of context-based advertisement by proposing a user-centric advertisement approach supported by infrastructure. Three cases were tested to validate the effectiveness of the approach. The key contributions of this hypothesis are twofold. • User context for user-centric advertising has been established. Test cases for a teacher, staff member, and students have been developed to test profile and activity context, considering factors such as age, gender, designation, and address to infer preferences related to mood, style, and living situation. • The proposed architecture design and implementation of a user-centric approach aims to provide users with the most relevant advertisements based on their logical context. This research seeks to further explore and expand the possibilities in this field. Advantages of User-Centric Advertisement using Software Sensors Technique: Targeted advertising uses software sensors to gather user data for more efficient and personalized campaigns. Real-time monitoring allows for adjustments to strategies, leading to a better user experience. This can result in increased revenue, but there are limitations such as privacy concerns, potential discomfort for users, and the impact of ad blockers on revenue generation. Data Processing, Storage, and Security Challenges for User-Centric Advertisement: The Challenge of Data Processing is to handle large volumes of data for real-time ad delivery. The solution is to use scalable processing systems and optimize algorithms for efficiency. The Storage Challenge involves managing vast user data while ensuring integrity and compliance. The solution is to employ secure storage solutions and implement regular data archiving and purging. Security Challenges include protecting user data from unauthorized access and breaches. The solution is to implement robust security measures and comply with relevant laws. The Data Collection Challenge involves addressing user concerns about data collection and personalized advertising. The solution is to prioritize transparency, provide user control, and obtain explicit consent for sensitive information.

2 Literature Review

The focus of this section is on user-centric advertisement design, where the goal is to create a design that is both dominant and invisible. This approach involves designing and implementing advertisements that cater to user preferences. The section will provide a detailed background on this notion and its architecture, and then offer practical guidance on how to extract user-centric design based on user preferences.

2.1 The Vision of Pervasive Computing

M. Weiser's 1991 [1] research article discusses the idea that the most impactful technologies are the ones that become seamlessly integrated into everyday life. This concept of pervasive computing will change our perception of technology, as computers become ubiquitous in our daily activities and social connections. Weiser[1] and Beigl et al [6] both emphasize the idea that when people become accustomed to technology, it becomes invisible to them. Invisibility

in computing allows seamless interaction between users and their environment, enabling access to computing at any time and location. Pervasive computing integrates devices and environments to enhance the user experience and collect contextual information for valuable services. Current search engines use web page content and keywords for targeted advertising. Context can also generate new types of requests, like place-based applications. Context is divided into physical and logical contexts. Physical context represents the user's environment, while logical context provides additional user and application information. Physical context properties are at a low level of abstraction and can be continuously updated. Context-aware applications are needed to improve user physical context semantics and create meaningful information for high-level decisions [7]. P. Prekop et al [8] proposed an activity-centric context model that considers both internal and external factors. Internal factors include user state, interactions, and social connections, while external factors can be measured through hardware sensors. Pervasive computing devices continuously monitor user activities and provide real-time information. A user-centric advertising model should accurately identify user requirements using publicly available information for generating and selecting advertising content.

2.2 The Software Sensors

We use software sensors to enhance context-aware systems by extracting context information from various sources and providing it to the decision-making modules[9]. These sensors are designed to sense changes in their environment and deliver corresponding outputs and are commonly used for processing multiple calculations simultaneously. They are particularly useful for data synthesis and fault identification in context-aware applications. Sunget al [10] categorized context services into stages, including the use of software sensors to observe and identify users' activity roles, relations, and entities within the system. These sensors track user movement and predict changes in context. Context-aware applications gather user context from sources like GPS, indoor sensors, and IP addresses.Software sensors collect data from a pervasive computing environment and use it to calculate context, creating different types of awareness. There are various software sensing methods available [11], with the most common being classified into two main groups: analytical or logical sensing techniques. These techniques rely on calculating measurements or estimating physical laws that govern the relationship of the quantity of interest with other available measurements and parameters.

2.3 Context-Aware Advertisement

Contextual advertising is a targeted form of advertising that appears on websites based on the content and user interests. It is run by search engines and returns relevant ads based on keywords in the website's content. For example, a sports website may show sports product ads and a travel website may show ads for discounted flights to specific destinations. Sports websites need to consider the user's gender, age, and finances Contextual advertising is a targeted form of advertising that appears on websites based on the content and user interests. It is run by search engines and returns relevant ads based on keywords in the website's content. For example, a sports website may show sports product ads and a travel website may show ads for discounted flights to specific destinations. Sports websites need to consider the user's gender, age, financial status, and purchasing power for targeted advertising. Context-aware advertising, or e-advertising, has become a significant source of revenue for search engines, blogs, commercials, news sites, and more. With the rise of the internet and the substantial increase in web traffic, there has been a significant growth in spending on e-advertising in recent years. In the figure, Q1 of 2022 had the highest growth rate of 21.1 compared to the previous year, with ad revenues increasing to 49.0 billion from 40.5 billion. However, the economy slowed down and higher interest rates affected companies' overall revenue, leading to a decrease in advertising revenues in the second half of the year. Q4 of 2022 had the lowest quarter-over-quarter growth rate of 4.4. Apple's App Tracking Transparency feature also hurt market players' revenues. In the first six months of 2022, U.S. ad revenues exceeded 100 billion for the

first time, a 16 increase from the first half of 2021. The second half of 2022 saw slower growth, with ad revenues increasing by 6 to 109.3 billion. More details are available in the figure.

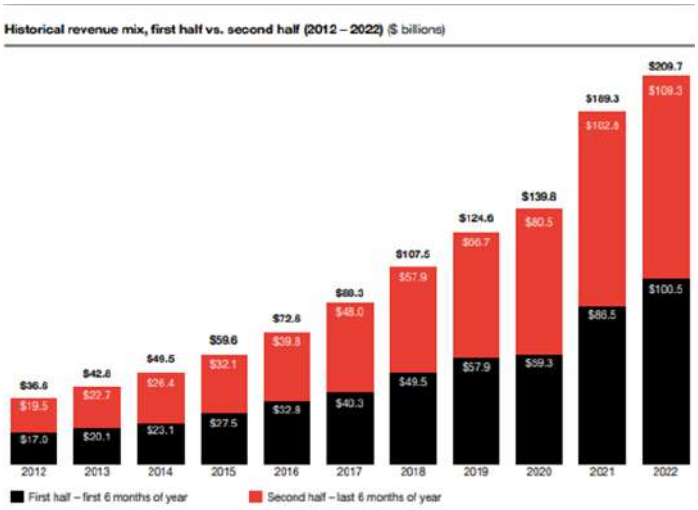

Figure 5. IAB Internet Historical revenue 2012-2022

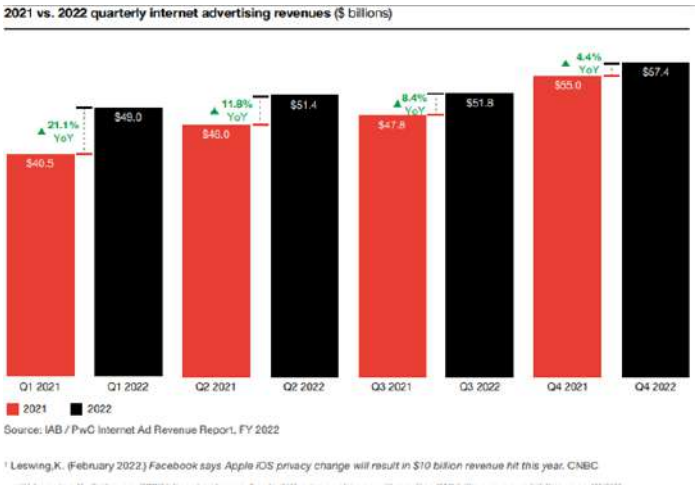

Figure 6. IAB Report 2021 vs 2022 quarterly internet advertisement revenue

In Figure, Q1 of 2022 had the highest growth rate of 21.1 compared to the previous year, with ad revenues increasing to 49.0 billion from 40.5 billion. However, the economy slowed down and higher interest rates affected companies' overall revenue, leading to a decrease in advertising revenues in the second half of the year. Q4 of 2022 had the lowest quarter-over-quarter growth rate of 4.4. Apple's App TrackingTransparency feature also hurt market players' revenues.

In their paper, Kantet al. [12] emphasized the importance of aligning advertisement content with the user's interests to enhance the user's experience and increase the likelihood of future interaction. They utilized interactivity context as a key factor in their study.

In their study, Nan Jing et al. [13] introduce a context-aware advertising framework that gathers and combines user contexts to choose, create, and display advertising content.

Ankit et al [14] proposed conceptual methods that transform website content into a conceptual space that displays the underlying concepts of the content. Bagherjeiran et al [15] developed a model for the user's current characteristics and combined web page content with user-relevant terms to select display advertisements. They used different terms as test cases. Pengqi Liu et al [16] discussed keyword extraction from webpage content and displayed ads accordingly.

2.4 User-Centric Advertisement

User-centric ad systems need user info for targeted ads, like gender, age, location, activity, education, emotions, and history. The authors have discussed contextual ad issues, like organizing user activity and matching ads. It's important to address these issues to match ads effectively.

Literature on content-based keyword matching for ads has been explored [13]. When someone searches on a website, an application will show ads based on the context and the user's current interests. For example, if someone is writing about the importance of horses in war, they may see ads for horse riding clubs or horse feed delivery. However, if the user is looking for information on report writing, the website will show ads related to that topic instead. Context-aware advertising goes beyond simply offering ads based on keywords. It involves incorporating past or previous activity records to generate a more personalized and relevant advertisement for end-users. This approach aims to increase revenue by targeting specific consumers and increasing revenue for both publishers and advertisers. Various

context-aware applications have been developed to gather user information and cater to their needs. Weinan Zhang and his team are specifically focusing on user behavior to target advertisements [17], [18], [19]. The necessary context information for the activity can be obtained in various ways, such as using hardware sensors, checking device status, and gathering network information. Alternatively, it can be obtained by manually browsing user-profiles and using other sources. However, an automated system can collect and analyze activity data, which can be more cost-effective than using hardware sensors. The service-based application can collect user data from Internet activity, email/Facebook transactions, or site registrations, but this data must be encrypted for security [20], [21]. User-service communication involves data to understand user activity context. Basic bio-data is available online and can be used for a knowledgebase system. Middleware can obtain user context from the internet. The context-aware internet access (CIA) sys- tem [22] acts as a proxy between users and websites, collecting user context from HTTP details, device IP, GPS location, and time information. Context-aware Internet Access [22] analyzes HTML text to extract information about web page titles, file sizes, link addresses, images, and other metadata, storing it in an XML structure for processing. Facebook Ads are tailored to users' preferences and targeted based on their age, activity, city of residence, and interests. The ads are informed by the information users have shared, their interactions with content, and their use of applications and websites [20]. The study analyzed context-aware advertisements [13] and their customization for users' activities. Users typically cannot update application utilities, so the applications must meet their needs without direct involvement. The applications use unspoken sensing and complex inference to support context awareness.

The research aims to develop automatic and dynamic context-aware systems that use software as sensors to sense users' activity context in context-aware environments. It also aims to identify and use users' context information from profiles and other sources, as well as analyze their interaction and previous activity from Google Drive usage and search engine activity history. This literature discusses approaches to user activity context, including obtaining, categorizing, and differentiating activity context, as well as structuring and transforming activity context data into knowledge base system. However, the heterogeneous context poses a challenge in mobile-based environments for collecting and analyzing activity context. Existing findings have not effectively identified and organized contextual information, such as keywords, current user activity, and user biodata. Despite the abundance of contextual information available, it cannot be effectively utilized to align with user intent and select target advertising content. These challenges are particularly relevant for intended user platforms with limited storage and processing capabilities, and new frameworks will be necessary to effectively address these issues [13]. On the other hand, Target Corporation, the second largest discount retailer in the United States offers a wide range of products. However, Walmart, another major retailer does not operate in Pakistan, so AdSense is unable to display its ads in the country. Instead, the contextual advertisement application works based on keywords and detects the user's IP address and country to display options tailored to their location.

3 Design Engineering

The system architecture has five main components, including one that acquires user context information from software sensors during communication with services. This information is obtained from two types of websites: static websites like YouTube and university websites, and interactive websites like Facebook and Twitter. This data is used to infer the user's activity.

The high-level design includes advertisement networks like Google's AdSense, Apple's iAd, Microsoft's AdCenter, and Yahoo's YAHOO/Bing Ad. These networks are connected to middleware or advertiser websites like Kaymu.com, Daraz.com, Zameen.com, Amazon.com, and Ebay.com, and can act as a middleman between sellers and advertisement networks, and sometimes between sellers and end-users.

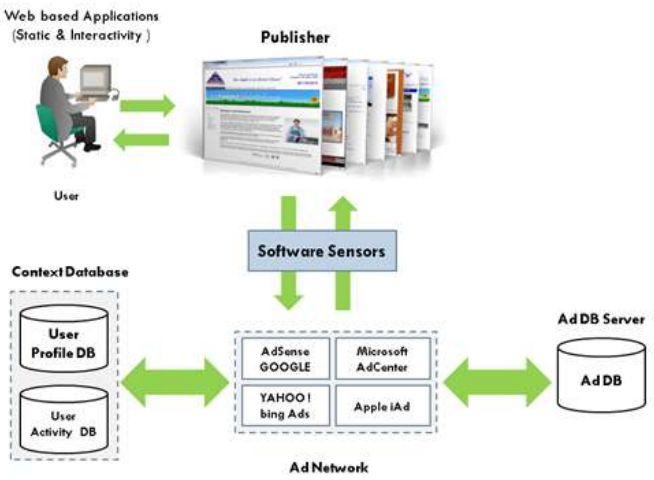

Figure 7. The Architecture of the system

Advertisement networks also share revenue with publishers.

Thirdly, a context database is utilized to store a user's profile and activity history. This includes basic information such as name, gender, financial status, and language, as well as previous activity records. This data is valuable for future use, particularly for advertisement networks seeking to target the user effectively.

The fourth type of database is an advertisement database, which stores information about products and services for publicity. Google's AdSense contains information about websites like Kaymu.com, Daraz.com, Zameen.com, Amazon.com, and Ebay.com, which display ads. AdSense selects relevant ads based on user activity on these websites. The user-centric ad system needs user info to provide targeted ads. Publishers and apps provide user context from websites, including gender, age, education, language, occupation, emotions, social connections, activity, location, and time. The ad network categorizes users into segments and targets them based on this info. We propose a more efficient high-level architecture. The components are detailed below.

3.1 The Sequence of the Methods

To design a high-level user-centric advertisement system and its components, the following sequences of methods are to be followed as defined in figure, this includes step-by-step user context extraction from the web and the publishing of ads. The user's context data is acquired by software sensors and analyzed to identify the user and their activity. This information is used to categorize the user's profile and activity and send targeted advertisements.

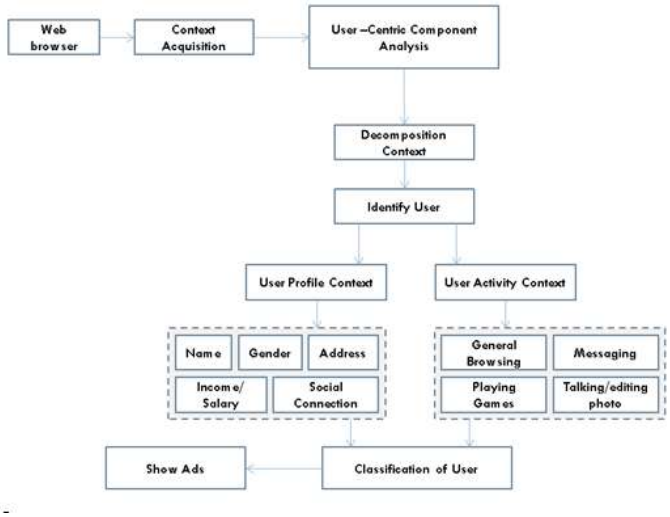

Figure 8. The Sequence of the Methods for the User-Centric Advertisement System

3.2 The Algorithm of the System

We tested our research by conducting a case study and implementing a user-centric advertisement design for our app, Sky Helper. The app provides location assistance, movie show times, and gas station information, delivering tailored ads based on user profile, activity, website content, and location.

The system in figure, uses basic user information from social media platforms to target users with relevant advertisements. By combining user profile information and activity, the system can effectively match user preferences with exclusive product information. This makes the system more context-aware and helps achieve the goal of pervasive computing. The user-centric ads algorithm identifies users through their basic profile information and activity linked with their user profile, starting with identifying their gender. Gender is crucial for targeting desired customers, and without this information, advertisements will be ineffective. Contextual advertisements

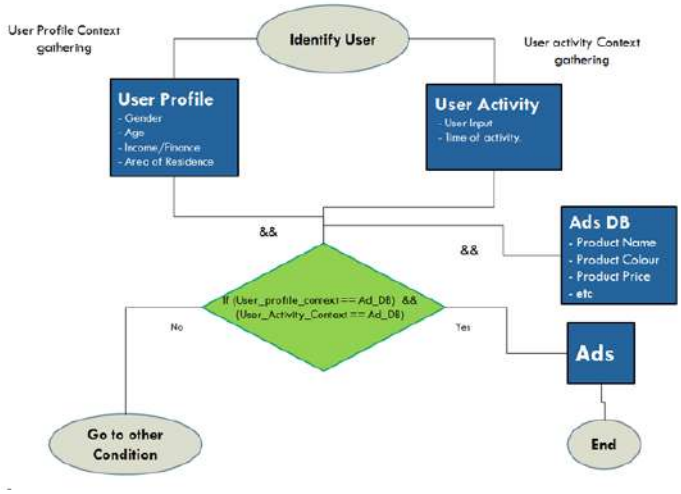

Figure 9. The proposed System Algorithm

should use current user information rather than previous search data. The figure shows the process of identifying the user, collecting user context, and matching it with advertisement context to display relevant ads. User designation information is crucial for purchasing. It includes details like income, financial status, and occupation to categorize users. Our proposed architecture targets users based on their profile and activity preferences, with separate cases for teachers, staff, and students. We have tested the algorithm with manual input and collected user context through ads networks APIs. Real examples, like Texlo.com's advertisement, show the inability to target users based on their country.

4 Implementation

In the previous section, we covered the engineering of user-centric advertisement design. Now, we have developed a context-aware application for user-centric advertisement. This application allows teachers, staff, and students to offer products based on their specific needs and interests, using their basic profile information and logical activity context on the web. We have tested the application on a desktop and uploaded it to the internet for real-time testing under the name http://user-centric-advertisement.tk/. [23]. the implemented application has three dynamic test cases, which we will define here for further discussion. For testing purposes, the user enters their data into the context-aware application of the user-centric advertisement system and then receives output in the form of relevant advertisements.

4.1 Test case of Offer a Shoes to the Male Teacher

Figures provide a snippet and code, respectively. A test case involves offering a pair of shoes to a male teacher living in a middle-class area. Context information will be provided by context providers/software sensors about the user's basic profile. After identifying the desired user, Mr. Jim, a university teacher with a tentative salary of more than 45000 thousand, a formal mood, and residing in the university society area, aged between 35-41, it is observed through his activity about seminars/conferences attended and previous and current activity about shoes. The desired shoes match his item description: color equal GRN, style equal formal, lace equal lace, oxford style, leather made, and price less than 5000 thousand. The user-centric system then offers him shoes according to his desired match.

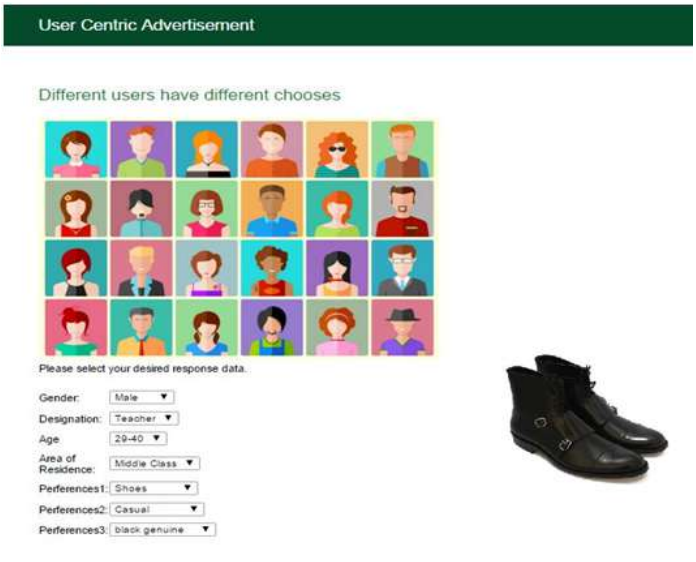

Figure 10. Test case of Offer a Shoes to the Male Teacher testing

```
<script>

    $("#pm").hide();
        if($( "#preference1 option:selected" ).text() == "Shoes"
        && $( "#designation option:selected" ).text() == "Teacher")
    {
        var newOptions = {
            "Please select": "Please select",
            "Casual":"Casual",
            "Formal":"Formal"
    };

else if($( "#preference2 option:selected" ).text() == "Casual")
        {
            var newOptions = {
            "Please select": "Please select",
            "black genuine": "black genuine",
            "genuine leather": "genuine leather",
            "Leather": "Leather" };
}
</script>
```

Figure 11. Test case of Offer a Shoes to the Male Teacher Code

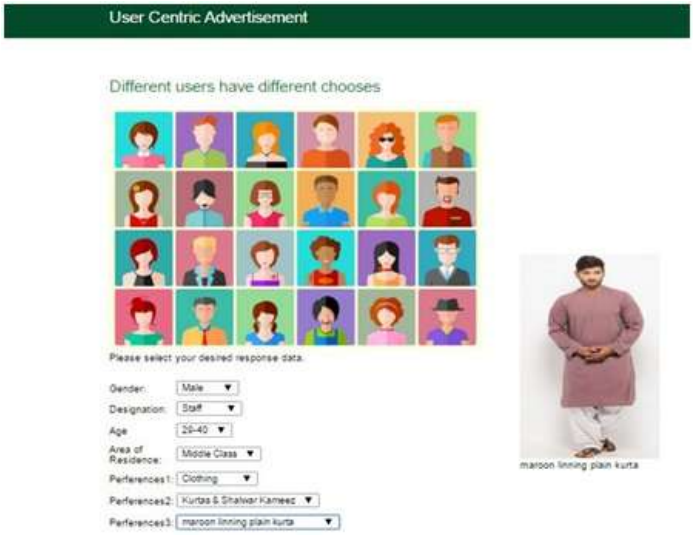

Figure 12. Test case of offering a kurta to the male staff testing

4.2 Test case of Offer a Kurta to the Male Staf

In Figure, a snippet from the application is provided, and in Figure 4.4, code is provided. The test case involves offering a Kurta to a male staff member living in a middle-class area. Context information is gathered from the user's basic profile and context providers/software sensors. After identifying the desired user, Mr. Jumman, a Lab. Assistant at the university, with a tentative salary of more than 25 thousand according to the Basic Pay Scale, and a mood-centric mix-formal style, a kurta is offered to him based on his interests and preferences. In all of these cases, limited advertisement options were tested online. The goal is to open the doors for user-centric ads on sites like Daraz.com and Kaymu.com. This will improve functionality and consider both user profiles and product descriptions. This targeted advertising will increase revenue and save user time.

5 Evaluation

In the implementation section, we have discussed the implementation of the three test cases algorithm that we developed to determine the suitable method to use in contextual advertisement, along with appropriate test cases to address the issues according to the users' intentions. We clarified that these methods are used to simulate the contextual information for execution scenarios. We also implemented a system and discussed a GUI-based website on the web. We used Notepad++ editor and the PHP platform on the XAMPP website development software. Through a review of literature and context-aware applications, it is observed that most of the work is done on keyword-based, query-based, content-based, and re-targeting. Initial results show that user profile information, product descriptions, and user activity will help with segment-wise targeting of customers. This project aims to work on contextual advertisement in line with the pervasive vision. Therefore, we have tested our aim through the objective of a user-centric approach and achieved our desired task. However, for testing from other users and their opinions for evaluation, we have received help from some participants, who are as follows:

5.1 Usability study

We have validated our framework to achieve our desired objectives of performing user-centric advertisement. It is generally acknowledged that any study requires validation through testing from users, such as

Figure 13. Test case of Offer a Kurta to the male staff code

White Box and Black Box software testing, as well as trial version testing. That's why we have enlisted the help of over 85 external participants. The majority of the participants are students at the University of Sindh, and most of them are computer users and E-buyers.

5.1.1 Participants Information

The participant information provided includes important details for targeting users based on gender. 22 percent of the participants are female, while 78 percent are male. Further information is shown here: Designation and financial status are important factors in purchasing products. This information tells the seller the purchasing power of customers and how many will pay for specific products. the details show the designation of the users, including teachers, staff, and students. Age is also a factor in user-centric decision-making, so we have collected age information and divided it into four sections: 18-24, 25-34, 35-45, and 46 and above. The user's role in the home and family makes them responsible for purchasing indoor and outdoor items. Information about this is important for a user-centric framework. We have identified key areas of user roles such as father, mother, children, and others like tenants and individuals living alone. the details show that 56 percent of users play dependent roles, 33 percent play key roles, and 9 percent are independent. Users' behavior is generally influenced by their level of education. Therefore, we have collected the education status of users. The education categories include SSC, HSC, Bachelor, Masters, and Doctorate for teachers, and also provide information about users' knowledge and ideas about internet advertisements, with 56 percent being familiar with e-ads and 44 percent having no the idea about internet advertisements. Additionally, the details show that 44 percent of users like advertisements, 14 percent dislike them, and 41 percent are neutral and do not interact with them.

5.1.2 Participants response

We collected user feedback in two phases: pre-system testing, which involved general questions about e-advertisement, and post-usage of our framework, which focused on the mechanism, ease of use, and advertisement output. We also gathered information about users' living environments, dividing them into high-class, middle-class, and low-class areas. The idea of targeting language-oriented users is a new concept. Metropolitan cities have diverse populations, but they have traditionally been treated the same based on demographic status. This poses a challenge when trying to target users. Therefore, it is important to address the issue of user language. Language is a major factor in contextual advertisement. We have identified common languages here. Overall user satisfaction with website advertisements is as follows: 23 percent are extremely dissatisfied, 19 percent are slightly dissatisfied, 21 percentage are neutral, 19 percentage are slightly satisfied, and 7 percentage are extremely satisfied. There is also a user feedback about email sidebar advertisements. Overall user satisfaction with website advertisements in this context is as follows: 28 percent are extremely dissatisfied, 23 percent are slightly dissatisfied, 26 percent are neutral, 19 percent are slightly satisfied, and 4 percent are extremely satisfied. Users responded to email newsletter advertisements as follows: 27 percentage extremely dissatisfied, 26 percentage slightly dissatisfied, 19 percentage slightly satisfied, 16

percentage neutral, and 12 percent were extremely satisfied. For Facebook sidebar advertisements, 14 percentage were extremely dissatisfied, 35 percentage slightly dissatisfied, 28 percentage slightly satisfied, 14 percent neutral, and 9 percent extremely satisfied. Some users dislike mobile SMS advertisements. 40 percent do not allow internet browsers to access their profile information, 26 percent do, 23 percent allow limited access, 9 percent ask about resisting or checking/unchecking options, and 3 percent do not care. After using the framework, 21 percent rated it very good, 37 percent as good, 23 percent normal, 9 percent suggested improvement, and 7 and 3 percent rated it bad and very bad, respectively. 54 percent of users are satisfied with the user-centric framework, 19 percent suggested improvement, 19 percent are not satisfied, and 7 percent are neutral. 64 percent found the exact product after using the legends, 21 percent did not, and 16 percent were unsure. Question about supporting our idea: 51 percentage of users selected "Yes," 30 percent selected "No," and 19 percent selected "Maybe" when visiting our webpage. Many internet users find ads to be unreasonable and spam-like, but we believe that contextual advertisements based on user activity and profile information will offer more relevant products and services.

Conclusion and Future Work

This thesis presents a user-centric advertisement framework for web-based ads, focusing on contextual advertisement to follow users' profiles and activity context. The research aims to utilize user profile information and activity context using software sensors for advertisement. The literature review covers pervasive computing, context awareness, contextual advertisement, and software sensors. The implementation and evaluation of the framework are also discussed. The report on Internet advertising revenue (IAB) [24] shows that Internet revenue is higher than other media for marketing/advertisement. Future directions include targeting users based on their language.

Author Contributions

Abdul Rehman Baloch: Conceptualization, Methodology, Data curation, Writing (Original draft preparation), Visualization, Investigation, Software validation, Writing (Reviewing and Editing). **Prof. Dr. Kamran Taj Pathan:** Supervision **Prof. Dr. Azhar Shah:** Co-Supervision.

Compliance with Ethical Standards

It is stated that all authors don't have any conflict of interest. Furthermore, informed consent was obtained from all individual participants included in the research work.

References

[1] M. Weiser, "The computer for the 21st century," *ACM SIGMOBILE Mobile Computing and Communications Review*, vol. 3, pp. 3–11, 1999.

[2] I. Kim, H. Goh, N. Narziev, Y. Noh, and U. Lee, "Understanding user contexts and coping strategies for context-aware phone distraction management system design," *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies*, vol. 4, no. 4, pp. 1–33, 2020.

[3] S.-F. Wen and B. Katt, "Exploring the role of assurance context in system security assurance evaluation: a conceptual model," *Information & Computer Security*, 2023.

[4] M. Maroto-Gómez, S. Marqués-Villaroya, J. C. Castillo, Á. Castro-González, and M. Malfaz, "Active learning based on computer vision and human–robot interaction for the user profiling and behavior personalization of an autonomous social robot," *Engineering Applications of Artificial Intelligence*, vol. 117, p. 105631, 2023.

[5] R. Suresh, "Open architecture/open business model net-centric systems and defense transformation 2019," in *Proc. of SPIE Vol*, vol. 11015, 2013, pp. 1 101 501–1.

[6] E. Mencarini, C. Bremer, C. Leonardi, J. Liu, V. Nisi, N. J. Nunes, and R. Soden, "Hci for climate change: Imagining sustainable futures," in *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*, 2023, pp. 1–6.

[7] M. Khan and S. Khusro, "Towards the design of personalized adaptive user interfaces for smart tv viewers," *Journal of King Saud University-Computer and Information Sciences*, vol. 35, no. 9, p. 101777, 2023.

[8] G. Y. Shien, K. Shanmugam, and M. E. Rana, "Automated face mask detection using artificial intelligence

and video surveillance management," in *2023 15th International Conference on Developments in eSystems Engineering (DeSE)*. IEEE, 2023, pp. 233–236.

[9] K. T. Pathan and S. Reiff-Marganiec, "Towards activity context using software sensors," *arXiv preprint arXiv:0906.3925*, 2009.

[10] E. Sung, D.-I. D. Han, and Y. K. Choi, "Augmented reality advertising via a mobile app," *Psychology & Marketing*, vol. 39, no. 3, pp. 543–558, 2022.

[11] L. Ge, T. Du, C. Li, Y. Li, J. Yan, and M. U. Rafiq, "Virtual collection for distributed photovoltaic data: Challenges, methodologies, and applications," *Energies*, vol. 15, no. 23, p. 8783, 2022.

[12] S. Kant and F. D. Yadete, "Neuro-marketing in understanding consumer behavior: Systematic literature review," *RADINKA JOURNAL OF SCIENCE AND SYSTEMATIC LITERATURE REVIEW*, vol. 1, no. 1, pp. 1–13, 2023.

[13] N. Jing, Y. Yao, and Y. Ru, "A user context-aware advertising framework for the mobile web," in *Handheld Computing for Mobile Commerce: Applications, Concepts and Technologies*. IGI Global, 2010, pp. 1–15.

[14] A. Patil, K. Dave, and V. Varma, "Leveraging latent concepts for retrieving relevant ads for short text," in *Advances in Information Retrieval: 35th European Conference on IR Research, ECIR 2013, Moscow, Russia, March 24-27, 2013. Proceedings 35*. Springer, 2013, pp. 780–783.

[15] A. H. Bagherjeiran, A. O. Hatch, A. Ratnaparkhi, and A. S. Joshi, "Contextual advertising with user features," May 12 2015, uS Patent 9,031,863.

[16] P. Liu, J. Azimi, and R. Zhang, "Automatic keywords generation for contextual advertising," in *Proceedings of the 23rd International Conference on World Wide Web*, 2014, pp. 345–346.

[17] J. Budzik and K. J. Hammond, "User interactions with everyday applications as context for just-in-time information access," in *Proceedings of the 5th international conference on intelligent user interfaces*, 2000, pp. 44–51.

[18] L. Finkelstein, E. Gabrilovich, Y. Matias, E. Rivlin, Z. Solan, G. Wolfman, and E. Ruppin, "Placing search in context: The concept revisited," in *Proceedings of the 10th international conference on World Wide Web*, 2001, pp. 406–414.

[19] W. Zhang, L. Chen, and J. Wang, "Implicit look-alike modelling in display ads: Transfer collaborative filtering to ctr estimation," in *Advances in Information Retrieval: 38th European Conference on IR Research, ECIR 2016, Padua, Italy, March 20–23, 2016. Proceedings 38*. Springer, 2016, pp. 589–601.

[20] Facebook, "Facebook - your page title," https://www.facebook.com/your-page-url, 2023.

[21] G. Drive, "Google drive: User activity on google drive through gmail," https://www.google.com/drive/, 2023.

[22] M. Burnett and C. Chapman, "Context-aware internet access," in *Proc. The 6th Australasian Document Computing Symposium*, 2001.

[23] A. R. Baloch, "User-centric advertisement," http://user-centric-advertisement.tk/, 2023, accessed on 04.03.2023.

[24] I. A. B. . PricewaterhouseCoopers, "Internet advertising revenue report 2022," https://www.iab.com/wp-content/uploads/2023/04/IAB_PwC_Internet_Advertising_Revenue_Report_2022.pdf, April 2023.