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A Scoping Review of Artificial Intelligence Research Trends in Mobile Applications

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Abstract - Over the past decade, mobile devices have become an integral part of our daily routines, offering a broad spectrum of applications that enhance everyday tasks. As more people adopt smartphones, developers are increasingly focusing on improving app quality, particularly by incorporating artificial intelligence (AI) features. This growing trend has led to a surge of interest from both researchers and industry experts, who are aiming to explore AI integration in sectors such as healthcare, education, agriculture, and e-commerce. This study conducts a thorough review of AI applications on mobile platforms by analysing 98 scholarly articles published between 2014 and 2024 from databases including Scopus, IEEE Explore, and Science Direct. After screening for relevance, 50 articles were selected for in-depth evaluation. The findings show a significant emphasis on healthcare, which accounted for 38% of the reviewed studies, followed by agriculture at 30% and education at 18%. This advancement is in line with societal demands because AI-powered mobile apps improve vital industries like healthcare, agriculture, education, and corporate operations by offering predictive analytics. Notably, machine learning (ML) techniques were prominent, used in 66% of the articles, while deep learning (DL) appeared in 16%. The review also highlights convolutional neural networks (CNN) as a key algorithm, present in 56% of the studies. These insights demonstrate the profound influence of AI on mobile app development and point to emerging trends and future research opportunities in this field. The need for cross-platform AI development has increased dramatically as AI continues to transform mobile technology. This strategy is essential to the scalability, accessibility, and effectiveness of the larger mobile app ecosystem since AI-enabled apps are designed to function flawlessly across a variety of mobile operating systems (iOS, Android, etc.).

Keywords— Mobile Device, Artificial Intelligence, Mobile Applications, Literature Review, Research Trends.

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1. INTRODUCTION

One of the most important and deeply personal devices for people today is their mobile phone. Over the past five years, consumer interest in 'mobile phones’ has grown relative to other platforms such as “desktop computers”, “laptop computers” and “tablet computers” [1], [2]. The widespread use of mobile devices has firmly established them as People use smartphones for a variety of things, using a wide range of mobile apps for things like social media sites such as Facebook, LinkedIn and Twitter, email, instant messaging, online shopping, web browsing, entertainment and other Internet of Thing’s (IoT) services such as smart cities, health and transportation [3], [4]. When creating an app, it is important to consider certain characteristics of intelligent applications that help mobile device users with their everyday tasks, such as action-oriented, context-aware, adaptive, expressive, decision-oriented, and data-driven features [5].

AI has dramatically changed the way we interact with technology and has recently accelerated technological breakthroughs that have impacted several industries, including healthcare, commerce, agriculture, education, entertainment, manufacturing, energy, transportation, and logistics. AI is gradually being integrated into mobile devices to facilitate appropriate data retrieval and intelligent processing [6]. In the context of computing with smart mobile devices - which traditionally operate intelligently - AI techniques have expanded rapidly in the recent past [1], [2]. Recently, many applications in smart mobile computing have been investigated using models based on AI and their real-world application. These include personalized recommendations or suggestions, virtual assistants, mobile business, agriculture, and healthcare services for disease management and detection.

The use of AI in mobile apps has undoubtedly been innovative for commerce; the global AI market is expected to be worth around $2 trillion by the end of 2030 [7]. Mobile app development has been transformed by the advent of AI. As AI offers a variety of capabilities, it can be used to provide apps with more effective, understandable, and secure features. Integrating AI into mobile apps can bring numerous benefits, such as improving the user experience, illuminating app functionality, and supporting customized interactions. AI technology is making remarkable progress and is expected to solve the lack of human reserves in many areas. Similarly, the mobile industry is moving forward by applying AI to mobile application development to improve the effectiveness of mobile apps [8]. DL, computer vision, natural language processing (NLP), ML, expert systems, and other fields have emerged because of AI's advancement.

This review of published papers aims to offer a comprehensive synopsis of the application of AI in mobile applications. The objective is to gain insight into three key areas: (i) the most prevalent methods employed in AI-based mobile app development, (ii) the domains in which AI is being applied, and (iii) where the papers have been published.

This paper remaining sections are arranged as follows: The background information and literature review are provided in section 2. Section 3 outlines the technique, and the methodology used to create the scoping review. Section 4 summarizes the key findings, connects them to the review question and goals, and examines the discussion of the findings. Section 5 concludes by offering a broad interpretation of the findings in relation to the review issue and the direction of future study.

2. LITERATURE REVIEW

In this section, we provide a summary of mobile apps, AI, intelligent mobile applications and related works that are in the scope of our study.

2.1 Mobile Applications

The smartphone market for mobile applications has grown exponentially due to recent advances in science and technology [1]. These devices are also considered to be some of the most important IoT devices due to their numerous functions, including data processing and storage [2]. Modern smartphones have also been described as “a next-generation, multifunctional mobile phone that enables both data processing and enhanced wireless connectivity”, or alternatively as a hybrid of a “wireless-enabled PDA” and a “powerful mobile phone” [3]. Today, mobile phones are extensively utilized in various demanding areas such as online education, telemedicine, online shopping, digital travel, and virtual coaching. As a result, mobile phones are transforming from a simple container of thin clients to a container of many mobile applications providing various services for our daily life [9], [10].

The overall count of mobile application downloads from the Apple Store and Google continued to increase between 2016 and 2022. However, in 2023, the global number of app downloads deteriorated, reaching 257 billion downloads and experiencing an increase of only one percent over the previous year [11]. The mobile app industry is

expected to yield over $613 billion in revenue by 2025, with mobile games representing the highest proportion of income across all app categories. The e-publishing and education industries continued to experience a restricted market for their mobile offerings, even though app usage surged due to the COVID-19 pandemic, which disrupted the conventional educational system.

The smartphone experience is evolving, with most applications in the leading app stores available for free download. Nevertheless, the increase in worldwide consumer expenditure on apps over the past few years indicates a strong demand for premium services or paid app content. In the second quarter of 2021, Android consumers spent an average of US$5.31 per mobile device, after peaking at an average of US$10.6 per mobile device in the last quarter of 2020 [11]. By September 2021, the number of paid apps in the Apple App Store and Google Play Store had shrunk to just six percent and four percent of the total, respectively. In contrast, applications that provide subscription options are gaining more traction in the monetization field.

2.2. The Importance of AI in Mobile Applications

AI has received a lot of attention since the idea was projected, and it has recently made rapid progress with applications in various fields [12]. Therefore, with the latest iterations of smartphone hardware technologies, which have excellent data processing capabilities, AI capabilities have been exploited. With the recent advancement and increased usage of mobile devices, the number of mobile applications (apps) has increased significantly in recent years. Recent advances in DL and AI technologies have empowered several mobile applications. Researchers have explored intelligent analytics by integrating smartphones with AI algorithms [6]. While cloud computing and mobile sensing are the foundations of traditional computational paradigms, mobile AI offers several advantages. These advantages include low communication bandwidth, low cost of cloud computing resources, fast response time, and improved privacy [13].

Mobile applications using AI take advantage of a machine's ability to understand and respond to stimuli to provide optimal user experience. The primary goal of integrating AI into mobile applications is to alleviate users' everyday problems and improve their quality of life [14]. To increase user engagement and solve difficult problems, AI may be able to extract essential data from mobile devices, such as contacts, location, and daily activities. AI-enabled applications can collect and store data by analysing user behaviour and interaction. This capability paves the way for the development of AI-powered mobile applications that streamline and transform human needs. Mobile applications with AI capabilities can be developed by taking advantage of many of the benefits of AI.

AI in mobile applications is revolutionizing how businesses function, interact with clients, and add value. Mobile apps with AI capabilities are now more than just new technology; they are essential to contemporary businesses' competitive strategy [15]. AI makes it possible for mobile apps to provide highly customized experiences, including recommendation engines, voice assistants (like Siri and Google Assistant), predictive text, and facial recognition. Additionally, they encourage innovation in finance to manage fraud detection, investment advice, spending tracking, and they give firms real-time information and data [16]. These mobile apps are essential to the structure of the digital economy because they allow for more intelligent services, more efficient operations, and more individualized client interaction [46]. Businesses hoping to prosper in a digitally driven future will need to seamlessly integrate AI technology into mobile platforms as it develops [17].

There is currently a significant amount of research into the use of AI and ML in mobile devices to improve the quality of computation and create new application opportunities [8], [18], [19]. Examples of such applications include speech recognition, face unlocking, VR and natural language translation. On the other hand, advanced training and learning in ML require massive computing power. Modern AI techniques such as ML, DL, NLP, knowledge representation and expert systems can make target mobile applications smarter and more efficient.

2.3 AI Integration Across Diverse Mobile Domains

AI enhances mobile applications across multiple domains by providing intelligent, adaptive, and automated solutions. From personal assistants and health apps to finance, education, entertainment, and beyond, AI enables mobile apps to deliver more engaging and effective user experiences. The integration of AI into mobile applications continues to advance, driving modernization and changing the way users interact with technology.

2.3.1 AI in Mobile Healthcare Applications

Mobile phone technology has become part of people's everyday lives. Improvements in this technology have facilitated its use in various fields, including healthcare. Access to quality healthcare is urgently needed around the world due to health issues. In 2018, it is predicted that 1.7 billion smartphone users will download healthcare apps [20]. AI is transforming this rapidly growing profession by helping to identify risks, provide personalized care, and improve our understanding of various health issues. Scientific research in health and the development of new technologies involving smartphones and sensors are enabling self-care [21], [22]. For instance, mobile phones are proving to be more helpful in places where data communication via postal or road infrastructure is frequently delayed or unsuitable [23].

Mobile apps based on AI techniques have the potential to improve health outcomes: from personal health assistants and remote monitoring to mental health support and diagnostic assistance, AI is enhancing the capabilities of mobile apps to improve the health and well-being of users. As technology advances, the integration of AI into healthcare apps is expected to grow, offering even more sophisticated and impactful solutions. According to [24] software programs that utilize AI techniques to give users data and other relevant services via mobile platforms like smartphones, watches, and tablets are known as AI-enabled mHealth applications. These apps maintain health data, offer updated health suggestions, and recommend remote monitoring and analysis by utilizing ML algorithms to identify and react to user input.

Some important areas where AI is applied in mobile health applications are: personal health assistants for checking symptoms and medication reminders, chronic disease management for predicting and providing tips on how to manage diseases such as tuberculosis and diabetes [21], [25], [26], mental health for tracking mood and providing mental support, fitness and wellness for providing work plans and diet recommendations, and lifestyle and preventive health for managing stress levels.

A study on the application of an artificial neural network (ANN) for stroke detection and diagnosis is presented by [27]. The device uses a physical grid mattress that the patient can use at home and a neural network (NN) that can be trained to recognize typical limb movements of patients. Any changes in the patient's gait that might indicate a stroke were sent to a smartphone app.

Jimenez-Serrano et al. [28] presented a classification model to detect the risk of postpartum depression during the first week after childbirth, allowing for early intervention. A mobile application is being developed for the Android platform so that both new mothers and medical professionals who wish to keep an eye on their patients' tests can do so using the model. An intelligent eye Android mobile application is presented by [29]. Banknote recognition, item identification, colour detection, and light detection are some of the helpful functions that the application gives to visually impaired individuals. Regarding the unique clinical setting of women's health, including infertility, [30] proposes the creation of a collaboration between AI/ANNs and mobile applications for optimal personalized strategies.

An iOS mobile app is presented by [25] to detect tuberculosis based on chest x-ray images using a custom AI algorithm and sputum smear images. DL4DED, a DL method to detect depressive episodes on mobile devices, is presented by [31]. The technique makes use of long short-term memory (LSTM) networks with CNNs to recognize a patient's voice during impromptu phone conversations.

Theilig et al. [32] presented a mobile application using ML. It helps users as a pre-hospital treatment to prevent depressive moods and explores the motivation of digital mental health users who utilize an intelligent mobile app to complete self-assessment questions in their daily life. A mobile application is developed by [33] to detect abnormal heart activity using either a digital stethoscope measurement as input or a mobile recording of the heartbeat using the mobile phone's microphone. The signal is denoised using wavelet transform and then CNN to classify the stored heart sounds.

Cedeno-Moreno and Vargas-Lombardo [21] presented a mobile application that offers an evolving organized model of medical care for the self-management of patients with diabetes. By using a consistent dataset of Panamanian patients, it is possible to use ML models and determine the extent to which we can assist Panamanian physicians. Khaled et al. [34] proposed an approach using CNN, speech recognition, and smartphone camera calibration to facilitate the process of indoor navigation for visually impaired people. The CNN model is utilized for object identification, the phone's camera serves as the user's eyes, and speech recognition serves as the conduct for communication between the visually impaired person and the smartphone.

Gamble [35] described the social implications of using AI in mobile applications for MHapps. A mobile application using ML based on facial recognition technology and location using Google Maps is proposed by [36]. By including a notification feature, the program seeks to increase daily communication and the capacity to complete daily chores. The results show that the app helped people with signs and symptoms of Alzheimer's disease to support their daily life in a suggestive way.

A comprehensive mobile application that responds to the needs of the visually impaired community, executed with object recognition and text-to-speech technology, is developed by [37]. The objective is achieved by using a CNN algorithm to analyse images and recognize details that are described to the user through text-to-speech. An expert system-based Health application with AI support is presented by [38]. The application provides dynamic support for common health problems in daily life and was evaluated through survey and diagnosis-based assessment tasks. Tharushika et al. [39] developed an intelligent healthcare application for the classification and treatment of skin diseases and the prediction of heart diseases. The application, which captures images of skin diseases, is called KNeighborsClassifier.

iRetina, a mobile application that intelligently navigates the visually impaired, is presented by [40]. For those who are blind or visually handicapped, the camera on their phone serves as their eyes. It uses the YOLOv4 object recognition algorithm. Pascucci et al. [41] presented an AI-based offline mobile application for antibiogram examination. A user-friendly graphical user interface guides the user through the inspection on the same device while the application takes pictures using the phone's camera. The application's automated reading system for the measurement process achieves an overall agreement of 90% for weakness classification against a hospital standard automated system and 98% against manual measurement. The performance of the application demonstrated that automated reading of antibiotic resistance tests is feasible on a smartphone.

An AI-based application motivated by a genetic algorithm (GA) for tracking a user's energy balance and predicting the likely caloric intake required to meet daily caloric needs for obesity management is presented by [42]. The algorithm predicts potential meals needed to suit the user's demands by using the user's input data on desired foods chosen from a database and extracted records on the user's physical activity level, diabetes status, and cholesterol level. The possible foods needed to meet daily caloric needs are calculated and predicted using the food's micro- and macronutrients.

A hybrid (DL and NN) intelligent remote diagnosis technique for mobile health applications for stroke prediction and diagnosis is proposed by [43]. The techniques rely on electromyography (EMG) signal datasets to provide a substantial source of information for detecting normal and abnormal movements of stroke. RandomIA, a mobile application, is developed by [44]. It uses AI algorithms to provide diagnostic and prognostic predictions for COVID-19 and is expected to be extended to other diseases later. Triana et al. [45] proposed a scheme for selecting NN models that best fit the Health Mobile App. The app can predict possible medical conditions based on patient input. It also encourages patient participation in their own health and positive management to improve well-being in resource-limited settings.

To help migraine patients receive the best and most accurate therapy as soon as possible, a mobile device that combines ML with personalized healthcare mechanisms is introduced by [46]. The application creates an intuitive user interface that makes it easier to offer strong evidence about the consequences of patient health problems. Furthermore, ML training was created to treat patients according to pertinent demographic aspects of medical care, such reports and medical history.

Das et al. [47] presented a mobile ML application for post-stroke rehabilitation exercises. For post-stroke treatment, physiotherapists and neurologists recommend a variety of activities, including wrist and finger exercises, shoulder extension, elbow flexion, elbow extension, and shoulder internal and external rotation. The authors focus on the upper limb. The CNN-based ML mobile application has 100% classification accuracy. U-HEALTH, an Android app for preparing healthy meal plans for diabetic patients, is proposed by [26]. The app considers the patient's likeness, health facts, and allergy behaviour for the food. For meal preparation, the food is set to Sri Lankan food style.

Atopic App a mobile health app is presented by [48], the App is designed for patients and their caregivers. The app and its companion web-based patient education program, Atopic School, offer a way to increase patient and carer involvement and adherence to AD management.

A mobile app that uses a variety of ML algorithms to automatically predict a person's risk of developing diabetes is presented by [49]. Both a chosen private dataset and the available Pima Indians were subjected to the application. The accuracy of several ML and ensemble methods, such as logistic regression, random forest, KNN, decision tree, ebagging, AdaBoost, XGBoost, voting, SVM, and Naive Bayes, were assessed. To address the issue of unbalanced classes, the researchers use the SMOTE approach.

A smartphone application with an AI assistant to enhance a pharmaceutical company's shipping operation is proposed by [50]. The app was developed using the water fall approach and several computer tools. Functionality, usefulness, originality, and technology were the criteria used to evaluate the software.

LukaKu, a smartphone application that uses AI to detect and identify exterior wounds, is propose by [51]. It is anticipated that the app will be able to generate medication and first aid for each external wound label in addition to identifying the type of wound that develops.

2.3.2 AI in Mobile Applications for Business

With the advancement of network and communication technology, e-commerce has emerged as a new financial activity. This view essentially represents the direction of newly developing information technology-based businesses. Currently, e-commerce is one of the industries that makes the most use of AI by building a huge customer base, trying to recognize customer desires, conducting real-time research, approaching final solutions, and many other events [15], [52]. Traditional retailers are facing disruption from competitors who can deliver value to their customers faster through these new technologies [16]. AI has the potential to transform the retail industry, and its impact on retail is expected to be significant.

In [53], Android-based mobile accounting software was presented to provide valuable information to end-users. To provide helpful suggestions and recommendations, such as estimating the financial budget or identifying a suitable marketing zone for a particular sales agent, the system has an AI module that uses GA. The GA-based system achieves 88.33% classification accuracy in predicting the sales characteristics of sales representatives.

A location-based, cross-platform mobile application that provides current sales offer information according to individual user preferences is presented by [54]. NLP, DL, and ML techniques are used in the development of the program. In [17], a secure authentication solution to strengthen the security of mobile banking applications using CNN is presented, to provide an embedded facial recognition model in the app. The application is tested in different states and achieved very inspiring authentication accuracy on real faces. Thus, the application can reduce insecurity in the banking sector.

The authors explore the practical implications of implementing AI solutions in mobile retail applications [55], focusing on enhancing online shopping engagement while prioritizing user confidentiality. Their findings provide valuable guidance on the benefits of ethically integrating AI solutions into mobile retail applications while ensuring the protection of user privacy.

In addition, [56] introduced the Mobile App and Artificial Intelligence Business Innovation Cycle (MABIC), an innovative framework designed to encapsulate the fundamental aspects of AI-driven business strategies. The framework outlines a cyclical process that includes the identification of customer needs, the development of tailored AI solutions, and the continuous assessment of their impact on user experience and business outcomes. It emphasizes the collaboration between technology developers and retail stakeholders. MABIC fosters an environment where ethical considerations are central to innovation, which eventually leads to improved customer satisfaction and trust in AI applications.

2.3.3 AI in Educational Mobile Applications

The technical expansion of AI in mobile devices takes mobile education to the advanced level, providing opportunities by serving students in less time and achieving collaborative and adapted learning. Mobile applications to support the learning process in the educational field [57]. For instance, because AI can link students to virtual classrooms, virtual reality (VR) streamlines the learning process outside of the classroom to provide a full learning environment. In addition, AI-based chatbots offer modified online learning that turns the tutor into a chat discussion. This technique can evaluate the comprehension level of the students.

An Android application for handwriting recognition using DL has been developed by [58]. The user can click on a photo of handwritten text using the camera. In [59], an AI-based process for generating educational mobile applications from freehand-generated images was proposed. The design of the images is based on User Interface Design Pattern (UIDP) representations. The authors try to bring new ideas regarding the use of AI in language learning apps [60]. In [61] a discovery of the use of an ML approach to improve the efficiency of learning complex words for dyslexics is proposed. Additionally, it details the findings of an assessment of a mobile application prototype that assists dyslexic users in overcoming their reading challenges in real life while receiving proper care.

A novel framework for a mobile application to predict students' performance before they enter university is developed by [62]. The framework is based on the data of a university's students from the years 2009-2017 and predicts the students' GPA, tests their knowledge in different areas, and estimates the future of their performance. A mobile application using CNN for the diagnosis of communication disorders is presented by [63]. Audio recordings of children with normal and communication disorders are recorded for the Android application to evaluate the effectiveness of the app.

A mobile handwriting application used as a child-friendly teaching tool is proposed by [64]. The software allows children to learn on their own without the help of qualified teachers. CNN is used for character recognition. Kunang et al. [65] developed a mobile application to help read documents written in Komering script. The app uses CNN to classify Komering characters and DL to identify photos. NSUGT An Android application that is convenient for students is proposed by [66]. It warns via pop-up notifications when classes, tests, or assignments are about to end.

2.3.4 AI in Mobile Applications for Agriculture

Agriculture is an important part of human life. In many countries, agriculture is seen as an important sector with a major economic impact. Meeting people's food needs has become a legitimate concern due to significant population growth [67]. Over the past 20 years, there has been a significant increase in agricultural initiatives due to advances in AI. In addition, mobile AI applications in agriculture have become more widespread and have produced innovative and appropriate results. Due to their widespread use, mobile devices have been at the forefront of smart agriculture. Smartphone applications for precision farming have been developed to enable small farms to show their environmental constraints.

A smartphone application for the early identification of black Sigatoka banana illnesses and Fusarium wilt race 1 using DL is proposed by [68]. Their model was pre-trained using ResNet152 and InceptionV3 CNN architectures. The result shows the potential for improving the tool for early disease detection. A cassava plant health diagnostic system using smartphones is proposed by [69]. It uses ML to solve the problem of disease detection in the field by examining photos of plant leaves. It also demonstrated how the relevant features are extracted from the leaf photos and used to indicate disease. ML algorithms are then trained to distinguish diseases based on these structures.

The study discovers and implements the effective adaptation of ML approaches on a mobile platform [70]. The study uses microscopic samples and images of plant sections as input to identify Fusarium oxysporum cubense (Foc) in young, asymptomatic banana plants. According to preliminary results, there aren't any significant differences between the different feature extraction techniques. *k*-nearest neighbors (KNN) achieve the highest average accuracy in discriminating between infected and non-infected leaves compared to support vector machine (SVM) and Naive Bayes. KNN was shown to extract maximally stable extremal regions (MSER) features from microscopic images more accurately than SVM or Naive Bayes.

To identify foliar signs of cassava pests and diseases, the effectiveness of a CNN model set up offline in real time on a mobile device is assessed [71]. Using the single-shot detector model, a CNN architecture enhanced for mobile devices, the performance of the model is measured to detect noticeable and mild symptoms of 3 disease classes. A tool for distributed prediction of crop yield is developed by [72]. Based on various parameters such as location, farm size, temperature, rainfall, and crop records, the model provides farmers with comprehensive advice on how to maximize crop selection. A mobile app for Android has been developed to access the results of the ML analysis.

In the early stages of tomato plant growth, [73] presents a low-cost smartphone application that uses a CNN model trained on a dataset of tomato leaf photos for real-time detection and segmentation of Tuta Absoluta damage. In [74], a novel mobile application that uses a DL technique to automatically classify pests is described to assist specialists and farmers. The application employs a faster region-based CNN (Faster R-CNN) to detect pests using cloud computing. A database of recommended insecticides is also connected to the recognized agricultural pests to assist farmers.

A DL object recognition model has been used to create a mobile application that can identify and categorize plant diseases [75]. The Inception-v2 backbone network is used by the app to create a faster R-CNN object detector, enabling powerful and efficient detection. To automate the process of diagnosing plant leaf diseases, a mobile application using ML is presented [76]. To classify 38 disease categories, the app uses CNN as the underlying DL engine. Farmers can take a photo of the diseased plant leaves using an Android application as the user interface (UI). The confidence percentage and disease category are then displayed.

An approach to calculate sprinkler irrigation time has been proposed by, using CNN-derived in-field soil moisture values [77]. Using information from crop characteristics, sprinkler system parameters, and in-field soil photographs, a DL-based mobile application was developed to estimate soil moisture class. Water productivity, energy consumption, water savings, and accuracy of soil moisture class prediction were used to evaluate the system.

Dr. Fish, a mobile app that integrates CNN and recurrent neural network (RNN) to provide a holistic solution for the ornamental fish industry in Sri Lanka, is being developed by [78]. Both owners of ornamental fish and prospective business owners can benefit from the app's features, which include price prediction, fish disease identification, fish category prediction, and fish type recommendations. The application's compelling decision-making and user interaction have the potential to completely transform the market. An Android app for detection and classification of maize plant leaf diseases using the DL-based model You Only Look Once (YOLO) presented by [79].

An intelligent mobile-based system for the detection of yam diseases using CNN is developed by [80]. They use three groups of diseases, namely yam anthracnose, yam mosaic virus and health. The overall accuracy of the test data was 81.7%. A simple mobile app is proposed by [81] for the early detection of Black Sigatoka and Fusarium Wilt banana diseases. The app uses a DL model CNN that classifies these diseases, healthy banana leaves, and images that are not of a banana leaf or stem. The study integrates mobile technology and ML techniques to improve early detection and diagnosis of swollen shoot and black pod, which affect cocoa production [82]. A distributed application is being created that will enable farmers to snap a photo or video of the cocoa, and the software will immediately detect the disease. The app then uses an integrated information guide to recommend the best course of action.

2.3.5. Deployment of AI in Other Mobile Application Areas

An AI-based mobile application was created by [83] that can use a smartphone's built-in camera to take sensor images, identify the presence of sensor parameters, and categorize the level of those parameters based on the colour intensity found in training sets of the captured image using deep CNN (DCNN).

An application with a music coordination feature is developed by [84]. Users can synchronize music with another person and that person will be able to listen to identical music suddenly. The application also provides an exceptional feature of mood detection by checking the facial emotion using digital image processing (DIP) and playing music according to it. [85] developed a DL and cloud-based smartphone application to reduce the difficulty of finding a parking space. An LSTM model, which is based on DL and can easily handle large and multivariate datasets, was used to predict the occupancy rate of parking spaces. Models with different parameters and situations were developed and compared with SVM, Random Forest and ARIMA models to show the effectiveness of the model.

An iOS application for food and place image recognition using modified CNN models is developed by [86]. The application is innovative as it's the first creativity that transforms food and location ML models into the coreML iOS library and presents the results on an iOS application. A mobile application for selling used cars in Palestine is developed by [87]. To use the integrated ML algorithm automatically and eliminate the need for laborious data cleaning, the goal is to automate the data gathering and cleaning procedures. Random forest was chosen to be implemented into the mobile application.

The use of intelligent robots for intelligent content suggestions in mobile applications is suggested by [88]. AI virtual aided hosting robot system design, knowledge base design, and robot interaction control system implementation are all included in the app's design.

2.4 Related Works

A summary of AI-powered mobile health apps that offer mental health help is presented by [89], identifying areas where further research is needed. An online survey is presented by [90] to investigate how and to what extent individuals are willing to accept AI-based mobile apps for skin cancer diagnosis. The authors evaluated preferences and the relative importance of concerns, with an emphasis on younger age groups.

Abduljabbar et al. [91] provided an overview of AI techniques used worldwide to address transportation issues, primarily in the areas of public transportation, urban mobility, and traffic management and safety. An analysis of some of the limitations of AI applications in transportation allows for the completion of the review. In addition to reviewing the applications of AI in the design, operation and optimization of cellular networks, the paper provides a summary of the field [92]. The advantages and disadvantages of applying AI are specifically discussed, and a comprehensive analysis of the difficulties is made to provide new avenues for investigation. Su et al. [93] focused on learning what healthcare customers think about mobile health apps with AI capabilities. The research used a qualitative methodology and identified seven health domains and four AI structures that are used in state-of-the-art AI-powered health apps. The results specify that users have precise potential for each AI feature. They also find that most users do not understand AI or how (well) AI works in health apps due to the lack of such data and descriptions [94-98].

A systematic review of initial methods, with collective filtering, deep NN and transformer-based architectures, inspecting their application in various domains is presented by [1]. A specific emphasis is placed on multimodal and context-aware methods that support adaptive, scalable and privacy-conscious solutions

A literature review on how to observe AI chatbots, exactly as obtained through mobile applications for mental health care (MHapps), is presented by [99]. Attention is given to the social implications of these technologies. They conclude that human control is required for AI tools in mental healthcare, and therefore AI technologies should be designed to enhance mental healthcare rather than replace doctors.

A survey of recently created DL-based smart agriculture systems is provided by [100]. The study begins by outlining the significance of DL applications and the creative ways in which the methods can be used to address issues in agriculture.

Usman et al. [96] performed a thorough analysis that gave a broad overview of the developments and difficulties in ML-based test case generating methods for Android apps. 5 databases containing 845 published articles were chosen from a variety of journals and conferences. After that, 35 primary studies were identified after the chosen studies were analysed, categorized, and assessed using our precise metrics, which included the testing technique, testing approach, execution setting, ML technique, and ML algorithm. The findings of this study give researchers and practitioners insight into the usage of ML techniques for Android app testing.

Kulbayeva et al. [12] presented a review to analyse a range of mHealth solutions used to advance primary cardiac care. The study focuses on the factors that promote and hinder the uptake of mHealth services in clinics. The search was conducted using Scopus, scholar, Cochrane Library, PubMed and Web of Science from 2014 to January 2022. Their result confirmed that patients diagnosed with cardiovascular diseases are likely to benefit from the application of mHealth in cardiology.

An analysis of SARS-CoV-2 is presented in a review on the use of AI and smartphones together. They discuss the concept and impending expansion of virus detection, as well as the limitations of using smartphone research to identify SARS-CoV-2 [101]. They conclude that SARS-CoV-2 detection techniques based on smartphones and AI algorithms are promising and can be a useful complement to traditional analytical techniques. Srivastava [102] presented an overview of the role and challenges of using smartphone applications for precision oncology. In connection with the development and assessment of the (AI/ML) algorithms of these applications, the following topics were covered: the goal of these algorithms, an explanation of the techniques employed, the appropriateness and validity of the datasets, the design of the algorithms, the evaluation, the implementation of these algorithms, and post-treatment monitoring.

Rachad and Idri [5] carried out a systematic mapping study of the use of ML techniques in the design and development of mobile applications, targeting articles published on the subject between 1 January 2007 and 31 December 2019. The following criteria were used to choose, examine, and evaluate 71 papers in total: year, publication channels and sources, study and methodology type, data collection type, and, lastly, ML models, tasks, and techniques employed.

Usman et al. [14] provided a review that aims to capture the state-of-the-art research in the novel area of Android app testing using reinforcement learning published between 2015 and 2023. As a result, the study process includes seven criteria: problems addressed, reasons for using the RL technique, RL algorithms, events supported, testing techniques, validation, and evaluation methods.

Nahm et al. [103] offered a thorough analysis of dermatology uses of AI that have been authorised by the Food and Drug Administration (FDA) of the United States (U.S.) and other international organisations. It assesses the clinical application of these applications and their effects on healthcare delivery. Three FDA-approved systems in the United States were among the fifteen regulatory-approved AI devices found worldwide.

While the literature has reviewed and studied state-of-the-art application of AI in mobile applications during the period of their studies, they have not described the recent advancements, particularly some of the applications of AI in mobile applications in different domains. Therefore, the aim of this article is to improve previous reviews and surveys by integrating and giving emphasis to a select few newly.

3. METHODOLOGY

To have a synopsis of a particular research topic in a particular area, a comprehensive literature review is required. We adopt the method of performing SLR from [104], which includes the method of identifying, retrieving and interpreting the area of interest. The steps to be taken are specified in the following subsections.

3.1 Research Questions

The purpose of this study is to present a summary of research articles on the application of AI in mobile applications. The review will be conducted based on the research questions (RQ) constructed according to the Population, Intervention, Comparison, Outcome, Context (PICOC)principles.

a. **Population** - Articles presenting the application of AI in a mobile application.
b. **Intervention** - AI in mobile apps.
c. **Comparison** - Examination of all mobile apps in the most critical area using AI.
d. **Outcome** - The most advanced application of AI in specific domains for mobile apps.
e. **Context** - Studies that focused on presenting AI in the context of mobile applications.

In this paper, we applied seven research questions, which are:

RQ1 - To what extent is AI being applied in mobile applications being published? (Which publications, sources, and channels were used to publish the papers?)
RQ2 - What AI approaches are used to study mobile data?
RQ3 - What are the most common areas where AI has been implemented?
RQ4 - What are the most used AI algorithms?
RQ5 - What is the reason for implementing AI?
RQ6 - What is the most widely used platform?
RQ7 - Which evaluation metrics are commonly used?

3.2. Study Selection, Evaluation, and Review Process

This study adopts a literature review methodology to systematically analyse existing research articles. This method supports the development of a reproducible research framework, and its structured documentation facilitates a comprehensive examination of work within a specific domain [104]. Moreover, a literature review enhances objectivity and precision, enabling a well-rounded summary of current research trends and identifying potential future research paths. To carry out this review, literature searches were performed across four key academic databases: IEEE, ScienceDirect, Springer, and ResearchGate. The focus was on publications from 2015 to 2025 to ensure the inclusion of recent advancements. An initial pool of 118 papers was identified, which was subsequently filtered for relevance, resulting in 66 papers selected for detailed evaluation.

Following a defined process model, two targeted search strings were formulated based on the research questions: “mobile in artificial intelligence” and “intelligent mobile application.” Articles matching these criteria were gathered, after which the authors conducted a content assessment to evaluate the quality and depth of each publication, ensuring only the most relevant studies were included. In the final stage, papers specifically addressing mobile applications incorporating AI were selected for in-depth analysis. The selection workflow is illustrated using a PRISMA flow diagram in Figure 1.

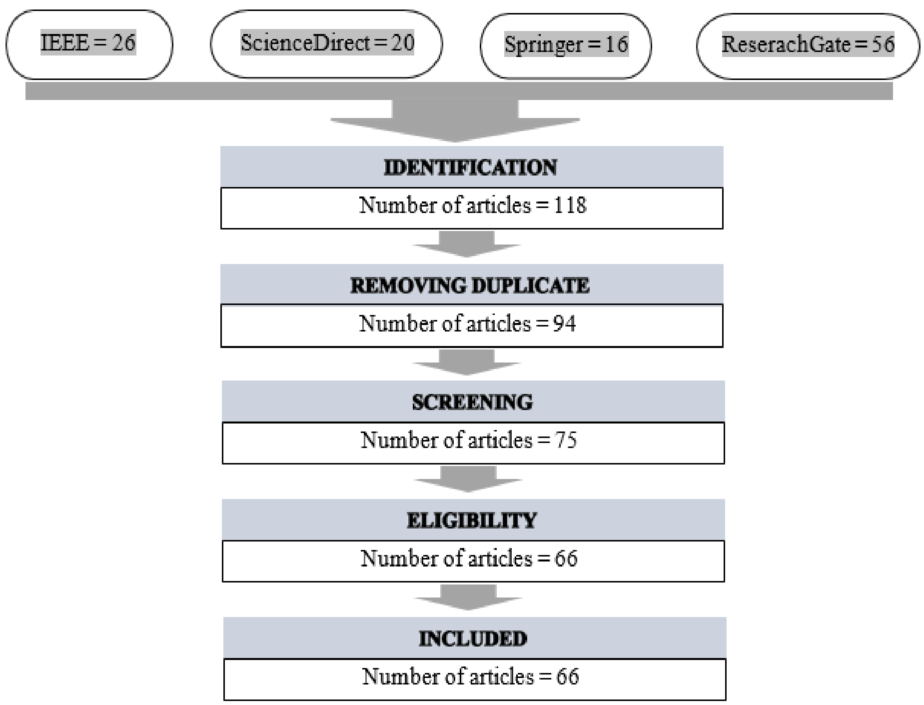

Figure 1. A PRISMA Flow Diagram of the Literature Selection Process

However, the selection criteria prioritized relevance, recency, and impact, ensuring the chosen papers were high quality and provided current insights on mobile application with AI. As a result, we omitted papers that solely addressed others. It's noticeable that this study encompasses several sequential stages within its review process. Firstly, a comprehensive literature search was conducted across databases to gather relevant papers on mobile applications with AI. Secondly, a two-stage screening process was employed to select primary studies that met the predefined inclusion criteria (refer to subsection 3.3). Thirdly, data extraction (refer to subsection 3.4) was carried out using a standardized approach to collect information on study.

3.3 Inclusion and Exclusion Criteria

Every chosen article is subjected to the inclusion and exclusion criteria. Software engineering and computer science have been selected as study areas. The inclusion and exclusion criteria used to choose the articles are detailed in Table 1. It is noteworthy that the authors made the effort to carefully sort through the papers, eliminating those that did not directly pertain to the research topic. By prioritizing papers with the highest relevance and significance for inclusion in the study, the goal is to ensure that only those with titles or abstracts that clearly contain the search phrases will be included.

Table 1. Inclusion and Exclusion Criteria Used to Choose Articles

Inclusion	Exclusion
Only English-language articles	Articles authored in languages other than English.
Articles that emphasize how AI is used in mobile applications	Articles that do not highlight the application of AI in mobile apps
Articles were released from 2014 until 2024.	Articles released prior to 2014.
Conference papers, journals, workshops, book chapters, and symposiums related to the application of AI in mobile application.	Books, technical reports, magazines, posters, and theses.
	Secondary studies that are reviews, SLR, SMS
Articles with three or more pages.	Articles with less than three pages.

3.4 Data Extraction

We collected all appropriate information from the selected studies to enable us to answer the RQs. We carried out data extraction and collation to observe and compare the relevant studies. In general, data extraction and gathering are carried out using a variety of available tools and software, including Microsoft Excel, Octoparse and Docparser. We use Microsoft Excel to record data from the selected articles in response to the constructed RQs; this will enable us to achieve the aim of the study. The following data was taken from every study that was included: authors, publication year, paper title, keywords, scientific databases/venue, publication type (e.g., journal, workshop, conference, symposium, or book chapter), publisher (name of the journal, workshop, conference, symposium, or book chapter), application domain (health, education, commerce, agriculture), supported platform (iOS, Android), AI branches (ML, DL, NN, expert systems, NLP, computer vision, fuzzy logic, robotics,), and AI algorithm.

a. Author refers to the author.
b. Year refers to the year in which the selected article was published.
c. Publication type refers to the publication venue where the articles were published, such as conference, journal and workshop.
d. Application area indicates the application area of the study, for example, health, business, education (learning) and agriculture. Study is categorized as generic if it does not define the application area.
e. Supported platform refers to the operating systems of the mobile devices. While several mobile operating systems are now available, Apple iOS and Android are the most popular. The end-user experience and the mobile operating system are approached differently by these two mobile operating systems.
f. AI technology refers to the classes that are used to extract information. We refer to ML and DL as AI technologies. Numerous AI technologies have been implemented in various domains to advance data processing and patient tracking.
g. The algorithms utilized to complete the learning task are referred to as AI approaches.

4. RESULTS AND DISCUSSIONS

The results of the review are presented in this section. First, we provide an overview of the selection method's findings; in addition, each research question's outcomes are provided in depth.

4.1 An overview of the Selected Studies

The studies were categorized according to the year of publication to determine the year with the highest number of publications on the application of AI in mobile applications. This helps to answer the following questions below.

RQ 1 - What is the intensity of publication on the application of AI in mobile applications? (which publications, sources, and years were used to publish the papers?).

The difference in the number of selected studies between 2015 and 2025 is shown in Figure 2. Additionally, compared to previous years, 2021 saw the publication of 14 papers, which is a noteworthy quantity. It is therefore very exciting to see that researchers are increasingly attracted to this area of research.

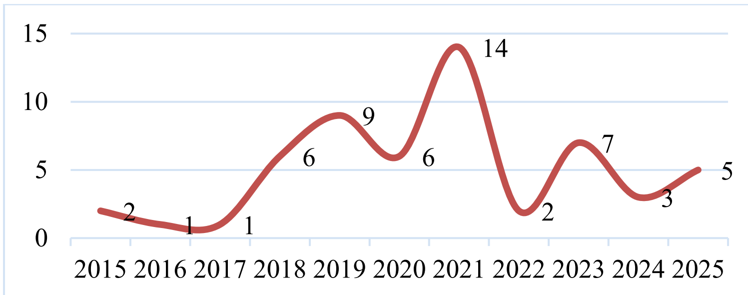

Figure 2. Distribution of Selected Studies According to Publication Year

The increase in AI-related research in mobile applications is evident, with a notable peak in 2021. This indicates that the demand for intelligent automation, increases in processing power, and data availability are driving interest in integrating AI into mobile apps.

Additionally, Figure 3 reveals that just 2% of the articles were published at symposia, 51% in journals, and 47% at conferences. Researchers frequently present their primary findings at conferences before publishing them in a journal article following the necessary confirmation, which explains the high rate of conference papers [105].

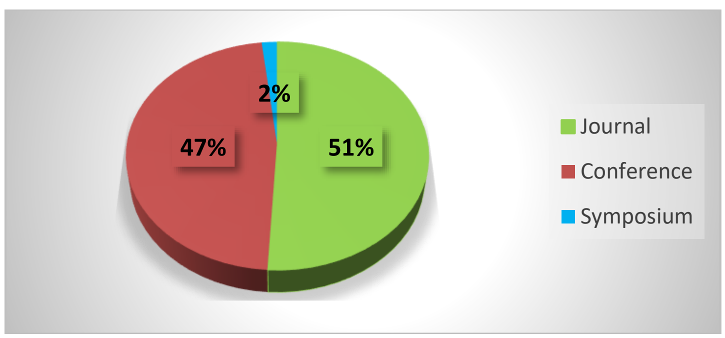

Figure 3. Publication Type of the Studies

RQ2 - What AI approaches are used to analyse mobile data?

AI approaches used to study mobile application data include a variety of techniques and methods from ML, DL, NLP and other subfields of AI. These AI approaches provide a powerful toolkit for exploring and extracting valuable insights from mobile application data.

Figure 4 shows that ML is the largest AI technique applied to mobile apps with a percentage of 45%, followed by DL with 38%, the combination of ML and DL with 6%, and the combination of ML, IP and ES with a percentage of 4%. Finally, other techniques have a range of 7%.

The preference for ML reflects its versatility in managing mobile data, enabling automation, predictive analytics, and customized user experiences.

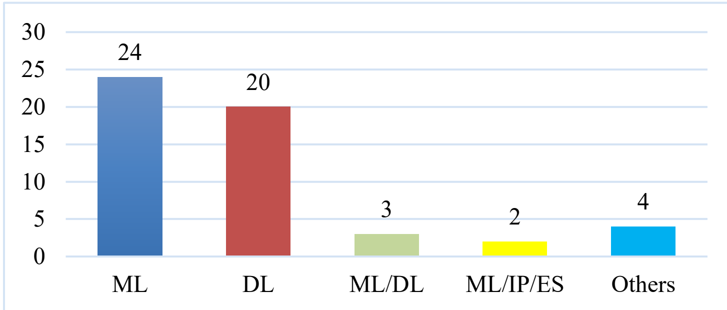

Figure 4. AI Techniques

RQ3 - What are the most common areas where AI has been implemented?

The total number of studies that focus on a detailed domain is better than those that are all-purpose. Furthermore, only 8% of the selected studies have proposed general solutions that can be applied to several areas, and 82% are concerned with a specific area. We can therefore see that researchers are concentrating more on the precise domain.

The discrepancy in the application domains implemented in the selected papers is shown in Figure 5. It shows that the most targeted application domains are health (43%), agriculture (27%), education (16%) and business (9%). The influence of health, agriculture and education applications can be explained by the fact that they have a huge social and economic impact on customers and businesses compared to other domains.

This development is in line with societal demands because AI-powered mobile apps can improve vital industries like healthcare, agriculture, education, and corporate operations by offering predictive analytics. Given the ongoing evolution of AI-driven mobile commerce and customer engagement tools, the paucity of research in business applications points to a possible field for more investigation.

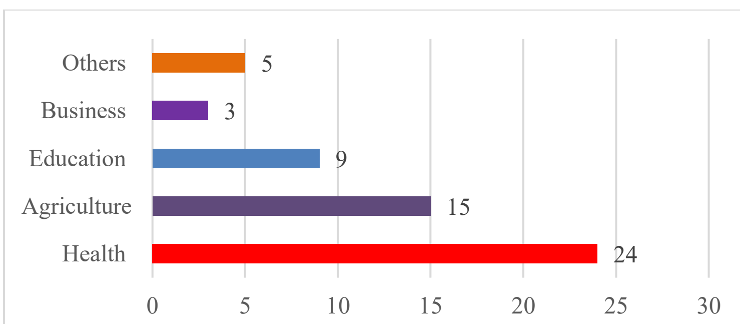

Figure 5. AI Application in Different Domains

RQ4 - What are the most used AI algorithms?

The application of AI algorithms in mobile applications offers a wide range of possibilities to improve functionality, user engagement, and provide advanced solutions, among others. By using ML, DL, NLP, computer vision and other AI technologies, developers can create intelligent and adaptive mobile applications that meet the evolving needs of users. Figure 6 shows that CNN is the most applied AI algorithm with 51%, although 17% used ANN, YOLO 7%, NN, CNN/RNN, RF/KNN, and KNN with 4% each. Finally, the rest of the algorithms such as NB, RF, and RF/NB have 2% each.

51% of AI algorithms are used by CNN, demonstrating their efficacy in image-based applications such as object detection, facial recognition, and medical diagnostics. There is potential for other AI techniques depending on application needs, even though CNN is still a powerful tool. This is indicated by the reduced usage of other algorithms like NN, RF, and KNN.

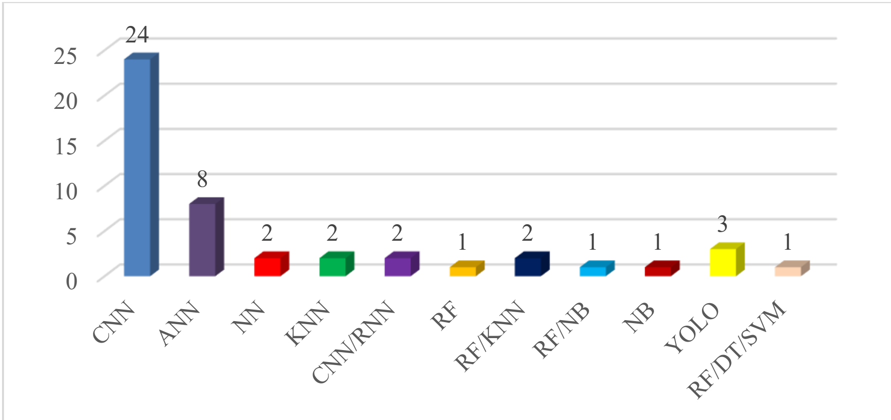

Figure 6. Most widely Applied AI Algorithms

RQ5 - What is the reason for using AI?

AI is being used in mobile applications to provide customized engagements, automate tasks, improve security, and generate engaging content. With AI, mobile apps can offer smarter, more instinctive and effective solutions, meaningfully increasing user satisfaction and engagement. Some of the reasons for using AI in mobile applications are classification, prediction, detection and diagnosis. Classification in mobile applications involves the use of AI algorithms to classify data into predefined groups. This is widely used in various domains to improve functionality, user satisfaction and overall app performance. Prediction in mobile apps combines AI to predict user behaviour, trends and events to improve app functionality and user experience. By leveraging predictive capabilities, mobile apps can provide more relevant, effective and active services, ultimately leading to higher user satisfaction and engagement.

Detection in mobile applications uses AI to recognize and respond to a wide range of patterns, objects and anomalies. By integrating detection capabilities, mobile applications can provide enhanced security, health monitoring and more efficient services. Diagnostics in mobile applications refers to the use of AI and ML algorithms to classify and analyse problems, conditions or issues based on data analysis. This capability is particularly valued in healthcare, device management and other areas where accurate and appropriate findings can have a significant impact on outcomes.

Figure 7 shows that classification is the most used reason for applying AI in mobile applications with a percentage of 31% (15 studies), followed by prediction with a percentage of 29% (14 studies), detection (10 studies) with 20% and diagnosis (1 study) with a percentage of 2%. The combination of detection and classification with a percentage of 10% and combination of prediction with diagnosis 4%. Finally, the combination of detection with prediction and classification with prediction comes in last with 2%.

A fundamental component of ML, classification aids in applications like sentiment analysis, spam detection, and medical diagnostics. The increased usage of prediction indicates that AI is being used to predict user behaviour, trends, and personalized recommendations, which improves the responsiveness and intuitiveness of mobile apps.

RQ6 - What is the most common platform?

A mobile device platform refers to the combination of hardware, operating system (OS) and software ecosystem that supports the development and execution of applications on mobile devices such as smartphones, tablets and wearables. In this study, we are interested in the OS. Software platforms known as mobile operating systems (OS) oversee managing and controlling the hardware and software resources of portable electronics like tablets and smartphones. These operating systems are designed to be lightweight, efficient and user-friendly given the resource constraints of mobile hardware. Several mobile operating systems are now available for mobile devices, with Apple iOS and Android being the most popular.

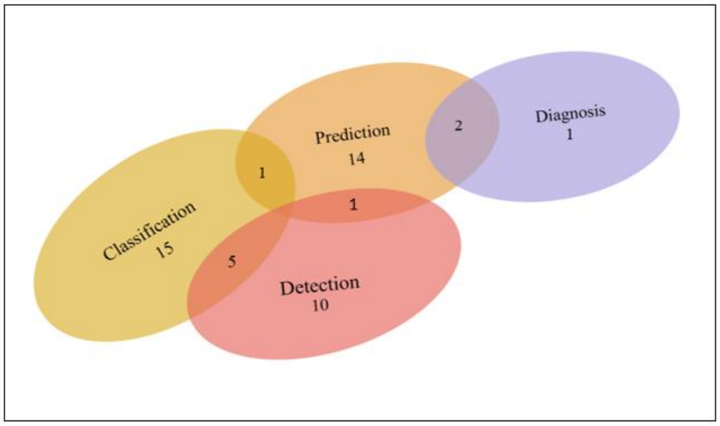

Figure 7. Reason for using AI

Figure 8 shows the percentage of mobile device operating systems in use. Android is the most used OS with 77%, followed by iOS with 14%, and the combination of Android/iOS with 7%. This discrepancy may result from Android's open-source architecture, which offers greater integration freedom for AI than the more constrained iOS ecosystem. Future studies, however, might investigate cross-platform AI solutions to enhance user reach and accessibility.

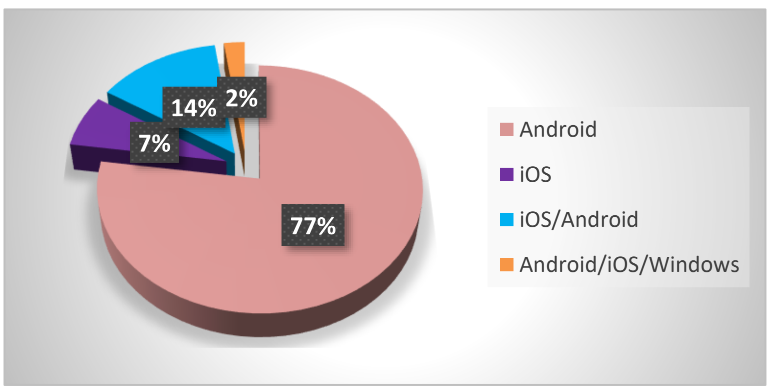

Figure 8. Platforms Used

RQ7 - What evaluation metrics are used?

Code coverage, defect detection, accuracy, efficiency and effectiveness are some of the metrics that can be used to evaluate how well an Android app is tested [105]. Evaluation is the systematic process of determining how a procedure, technique or method ultimately performs. Accuracy is a common and important metric when evaluating mobile apps, especially those related to ML models such as text prediction, image recognition and recommendation systems. Prediction is relevant for applications that integrate ML models to predict user behaviour, recommend content or predict outcomes. Figure 9 shows that the most widely used evaluation parameter is accuracy (65%), which reflects the importance placed on AI models' performance reliability. However, precision, recall, and F1-score are crucial measures to ensure balanced performance, particularly in classification-based applications, as accuracy alone is insufficient for a thorough model evaluation.

Other metrics may be required for a more thorough assessment. Precision and recall, particularly in classification tasks, provide valuable information about how well the model performs across different classes. However, the F1 score, which is useful for unbalanced datasets [106], [107], integrates recall and precision into a single statistic.

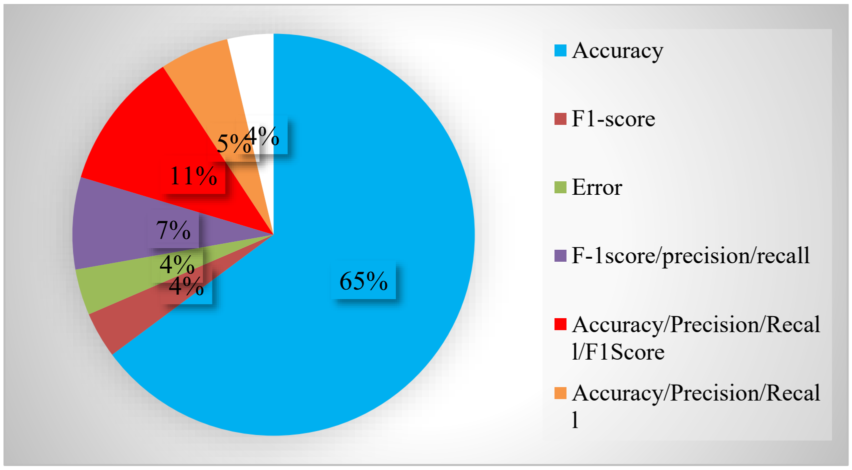

Figure 9. Evaluation Metric

By carefully selecting and monitoring relevant indicators, developers can ensure that their predictive models add significant value and improve the overall performance of the mobile application. Accurate predictions contribute to better decision-making, increased revenue and improved operations. They also improve the user experience by providing relevant and timely information and increase user engagement and maintenance by introducing a modified involvement.

5. CONCLUSION AND FUTURE RESEARCH DIRECTION

Recently, there has been rapid interest in the application of AI to mobile application development, as the demand for apps with artificially intelligent conveniences is growing due to the increasing use of mobile devices and smart applications. As a result, the integration of AI techniques and mobile technology in various fields such as health, education, e-commerce, agriculture and entertainment being promoted by both researchers and practitioners. Prior studies have emphasized the need for additional study to advance our understanding of and approaches to using AI in mobile applications.

This study aims to investigate and review the state of research on the use of AI techniques in mobile applications. Therefore, we conducted a thorough analysis of papers that have been written about the use of AI in mobile applications. We created a search string and ran it on Scopus, IEEE Explore, Science Direct, ACM and Science Direct to find recent research studies published between 2014 and 2025.

The results demonstrate how quickly AI is being used in mobile applications, especially in fields with a significant social impact like healthcare and agriculture. Nonetheless, there are still unanswered questions regarding cross-platform AI development and business applications. Future research could examine how to improve the capabilities of mobile applications by integrating AI with cutting-edge technologies like blockchain, augmented reality (AR), and the IoT. Furthermore, utilizing a variety of assessment measures might enhance the dependability and practicality of AI-powered mobile applications.

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AUTHOR CONTRIBUTIONS

Asmau Usman: Writing, Data collection and results– Original Draft Preparation.
Ibrahim Anka Salihu: Review and Editing.
Abdulrahman Aminu Ghali: Supervision and Editing.
Bilkisu Larai Muhammad Bello: Results and validation Writing.
Aminu Aminu Mu'azu: Methodology Writing and Editing.
Amina Sambo Magaji: Editing.

CONFLICT OF INTERESTS

No conflict of interests was disclosed.

ETHICS STATEMENTS

Our publication ethics follow The Committee of Publication Ethics (COPE) guideline. https://publicationethics.org/.

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