A research investigation on m-health using AI and Data science

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Abstract:

Mobile health (m-health) refers to the use of mobile phones and other patient monitoring equipment to track one's health. It is frequently regarded as the most significant technological innovation in the contemporary era. Artificial intelligence (AI) and big data analytics have recently been applied to m-health in order to provide a more efficient healthcare system. In modern medical research, several types of data such as electronic health records (EHRs), medical photographs, and sophisticated text that are diverse, poorly comprehended, and disorganised have been utilised. Due to the rise of mobile applications and healthcare systems, this is a significant factor for the emergence of numerous unorganised and unstructured datasets. In this research, a comprehensive review of the use of AI and big data analytics to improve the m-health system is conducted. Various AI-based big data algorithms and frameworks are also examined in terms of data source, methodologies used, and application area. This study investigates the use of AI and big data analytics to provide users with insights and enable them to plan, particularly for m-unique health's issues, and presents a model based on AI and big data analytics for m-health. The findings of this research will influence the development of approaches for handling m-health data more efficiently using a mix of AI and big data as a source.

Keywords: mobile, health, data, big data, medical

I INTRODUCTION

Alan Turing, the father of artificial intelligence (AI), characterised the discipline as “machine science and engineering, particularly clever computer programmes” [1]. Artificial intelligence refers to software that allows computers to simulate human cognitive functions. Philosophy, possibilities, demonstrations, and dreams all had a role in the birth of AI as well as creativity [2]. The area of IA arose in response to a number of concurrent demands, opportunities, and challenges. AI mixed with analytics (AIA) is becoming more widely used in a variety of industries, including healthcare. Medicine was, in fact, one of the most productive uses of analytics and is now a viable AI application area. Clinical apps were developed and suggested to doctors to support them in their practise as early as the mid-twentieth century. Clinical decision support systems, automated surgery, patient monitoring and aid, healthcare management, and other applications are among them. The present methods are mostly based on knowledge discovery using data and machine learning, ontologies and semantics, as well as reasoning, as we will see in the following sections. The various features of artificial intelligence explored in our paper were not chosen at random. It is noticed that they've developed a strong interest in medicine in recent years. Data mining techniques are frequently employed in learning and prediction, as well as imaging. Emotion and feeling are there in all of this, as well as speech processing. Because of their logic, ontologies are useful. Their ability, as well as their use as a means of comprehension, sharing, reuse, and integration, has gained traction.

Smart manufacturing systems necessitate creative ideas to improve the quality and long-term viability of manufacturing processes while lowering costs. Artificial intelligence (AI)-driven technologies, using I4.0 Key Enabling Technologies (e.g., Internet of Things, advanced embedded systems, cloud computing, big data, cognitive systems, virtual and augmented reality), are poised to create new industrial paradigms in this setting. [1] In this light, it's worth recalling that John McCarthy [2], the father of artificial intelligence, defined artificial intelligence in the 1990s as "the science and engineering of constructing clever machines, especially intelligent computer programmes." In general, when a computer duplicates functions that humans connect with other human minds, such as learning and problem solving, the term "AI" is employed [3]. The topics of artificial intelligence are divided into 16 groups on a broad scale [4–8]. Reasoning, programming, artificial life, belief revision, data mining, distributed AI, expert systems, genetic algorithms, systems, knowledge representation, machine learning, natural language understanding, neural networks, theorem proving, constraint satisfaction, and theory of computation are some of these topics [9– 11].

Mobile health is described as the use of mobile-based devices for medical and public health purposes, such as cell phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices. As a result, one of the most significant features of a mobile phone is the voice and short messaging service, which must be used in this procedure (SMS). Currently, more than 500 m-health initiatives exist, with almost 40,000 medical-based mobile applications available worldwide [1]. There are mobile-based medical gadgets created specifically for monitoring the heart rate [2], glucose level [3], blood pressure [4], sleep patterns [5], and brain activity [6]. It also makes use of more complex operations and services including the General Packet Radio Service (GPRS), 3rd and 4th generation mobile-based technologies, GPS, and Bluetooth-based technology. Medical images [10] are part of big data [7–9] in healthcare.

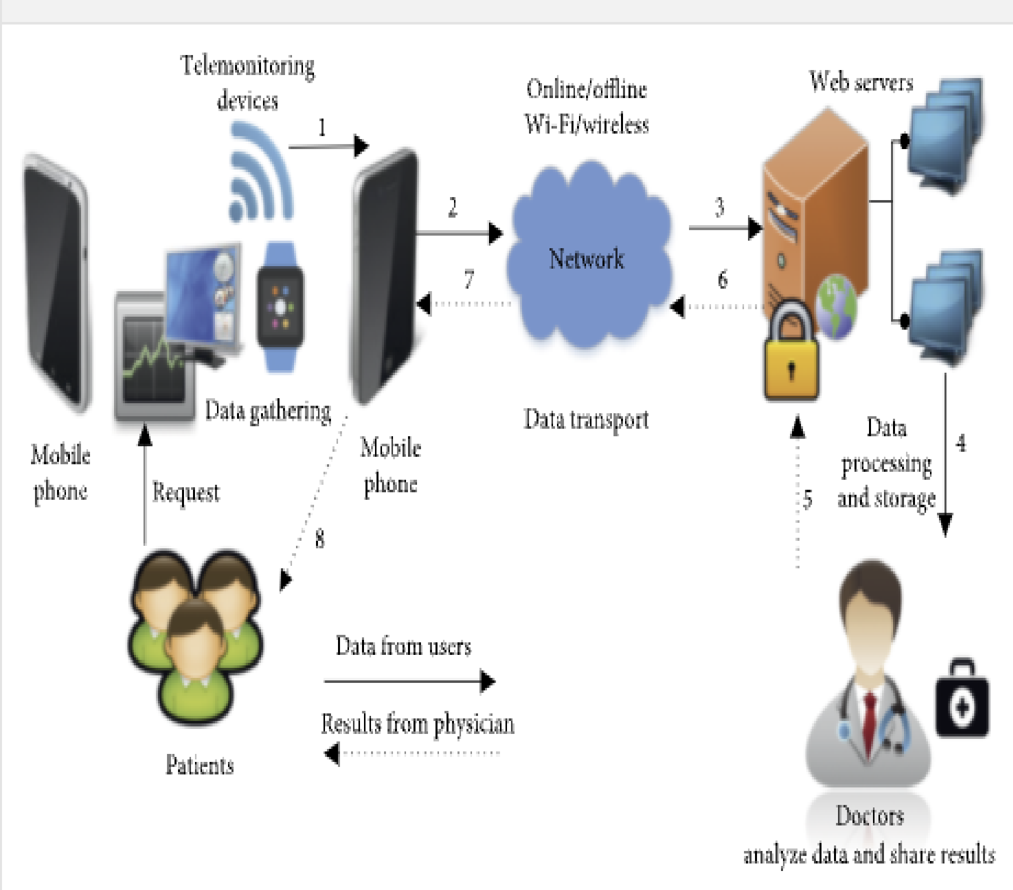

Fig. 1 Representation of m health scenario

This is getting increasingly popular in the global healthcare community. However, there is a lack of understanding of the best framework for this approach based on the computational approaches that are necessary. Big data analytics is the practise of analysing large amounts of data from a variety of sources [11, 12]. These data come in a variety of formats and forms. To analyse the data, several analytical tools such as data mining and AI can be used. Approaches for big data analytics can be used to spot anomalies that arise from merging massive amounts of data from a variety of sources.

II. Literature Review

Various works on m-health and applications of AI and big data analytics in the healthcare industry have lately been published as suggestions [14–28] or reviews [15, 27, 29–32]. Mobile phone applications have been effectively shown in medical-based monitoring applications and have improved clinical data assessment capabilities [27, 33]. In the process of examining the patient's linkages between events and disease course, methodologies such as experience sampling methods (ESMs) and ecological momentary assessment (EMA) were used. Because these applications process in real time, these strategies, which rely on giving informative material and self-administered questionnaires, reduce recall. Recently, mobile devices have been able to undertake passive data collection, i.e., acquiring information about users without them having to do anything. Actigraphy, geolocation, and communication-based activities are all common characteristics of today's cellphones, and they can be utilised to collect patient behaviour utilising m-health-based systems. These m-health apps were also utilised to keep track of a variety of physical and mental disorders from afar [31]. A mobile-based health app can use a variety of sensors to provide a patient's self-report. In [26], the authors presented a mobile application for detecting human activity through inertial sensors in order to assess the user's activity level during the recording process. Their approach additionally records the signal from heart rate and galvanic skin response to detect a user's emotional state.

This section describes the relevant papers and the method of selecting them for this systematic review.

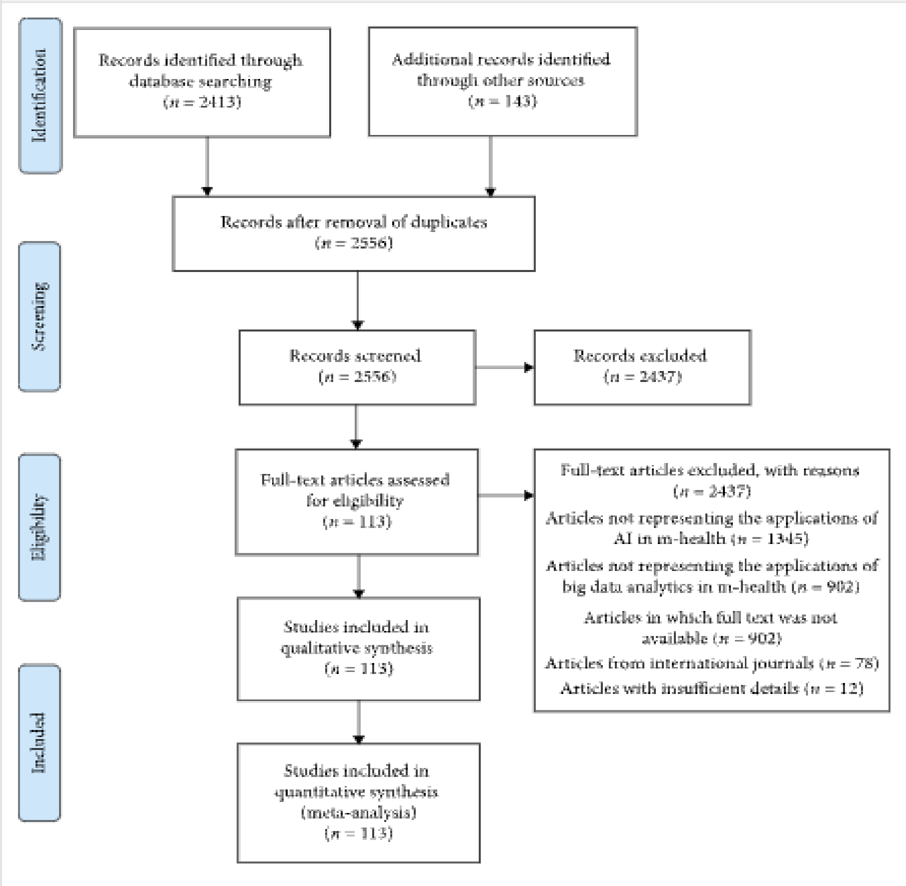

Fig. 2 Flow process of AI and DS

We examined eight significant scientific databases to find relevant publications for this systematic review: IEEE Xplore, ACM digital library, Taylor & Francis online, ScienceDirect, SAGE Journals, ProQuest, Springer, and Web of Science. An advanced keyword search strategy is used to accomplish this. The terms "Artificial Intelligence AND m-Health," "Big data analytics AND m-Health," and "AI AND big data analytics in M-health" were used in the search. A Google Scholar search turned up a number of papers. After finishing the article search, the authors used an inclusion and exclusion criterion to hide the names and abstracts of the papers found. Papers that were not in English, articles that lacked full text, articles that did not represent AI applications in m-health, publications that did not represent big data analytics applications in m-health, and articles with inadequate details were all removed. Duplicate articles were removed from the database. Finally, 106 articles were retrieved and stored for review.

II. Application of Artificial Intelligence in m-health

Artificial intelligence [24, 75, 76] is the process of robots demonstrating intelligence in contrast to human intelligence [24, 75, 76]. Machine learning is one of the AI applications that lays out the methods to build the ability to learn automatically and improve on its training without being explicitly programmed. It also emphasises the evolution of algorithms, as well as the ability to gather data and use it in the process of training themselves. AI has been used in a variety of disciplines, including IoT [22, 41, 77], machine vision [78], driver assistance [79, 80], and natural language processing [81, 82], due to its rapid advancement.

Larburu et al. developed an artificial intelligence-based m-health application for preventing heart failure in patients. At the moment, doctors are using simple approaches to generate alerts when diagnosing heart failure. The current methodology generates more false alerts. Predictive models were presented in this study to reduce the impact of false alarms. These predictive models are based on clinical data collected over 44 months from 242 heart failure patients' mobile phones.

Burns et al. [97] highlighted the importance of mobile-based multicomponent that may be used in AI models to assess many forms of emotions such as mood, cognitive state, depression, motivation, varied activities, patient environmental behaviour, and patient social behaviour. Their proposed methodology delivers feedback in the form of graphs for the process of behavioural self-reflection, as well as coaching from a variety of professional trainers. The proposed methodology is based on a combination of regression, decision trees, and sensor-based phone devices.

Hawley et al. [98] advocated using an automated computer to recognise dysarthria patients' speech. It also helps with the recording of voice messages. The authors used hidden Markov models to determine the overall proximity of a word spoken to a speech model that is tailored for a specific person in their method. However, in a real-life study involving nine people, the accuracy of their voice recognition methodology is only 67 percent.

Martin et al. proposed an approach for predicting and alerting patients about numerous modalities such as lung disorders or cardiovascular problems in [99]. Warnings were generated and transmitted to healthcare professionals who could monitor the alerts according to predetermined standards. Their suggested method was based on information gathered from patients' phone conversations. To teach the prediction models, linguistic and metalinguistic features were extracted together with the patient's status. Their proposed methodology produced a 70 percent positive predictive value for unforeseen events.

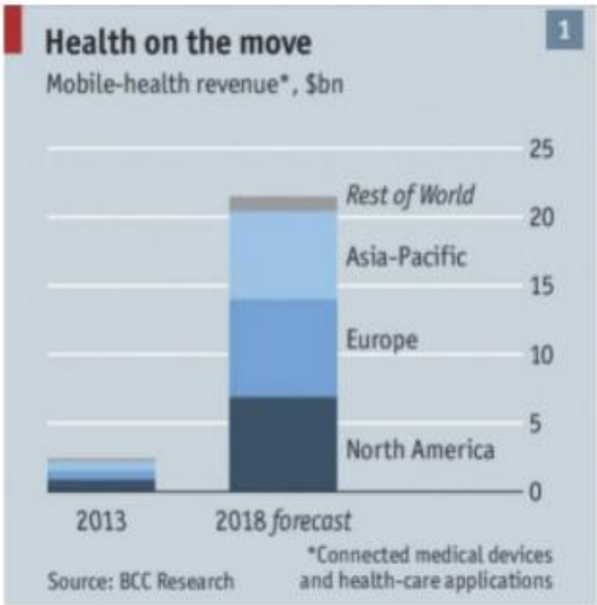

Fig. 3 Market of m-health

III. Application of Data Science in m-health

Big data analytics has recently been used to provide advanced patient care and clinical decision support in healthcare [14–17, 110, 111]. In general, the use of big data in healthcare refers to electronic health datasets that are large and complicated and challenging to manage using standard technology, software, tools, and procedures [11]. Clinical details of doctors, their notes and prescriptions, CT pictures, MRI images, laboratory data, documents from the drugstore, files from the insurance, and other data connected to administrative operations, EPR data, and so on are all examples of big data in healthcare. This is where big data comes into play. Various scholars have offered other approaches for processing these types of data. Still, there is a lack of understanding of the best framework for this approach based on the computational approaches that are necessary. As a result, big data scientists have access to a tremendous amount of healthcare data. By better understanding the benefits and drawbacks of this, big data analytics can be improved in order to save lives and lower the cost of data processing. As a result, large data can be divided into two distinct groups [36]:

Big data analytics is the process of evaluating a large quantity of data from diverse sources and formats in order to transmit the perspective of enabling a real-time decision-making process. To examine the gathered data, various analytics techniques such as data mining and AI can be applied. By evaluating a large amount of data from diverse datasets and their sources, these big data analytical tools can be utilised to uncover abnormalities. Figure 4 is an example of a smartphone-based m-health platform that uses AI and big data analytics.

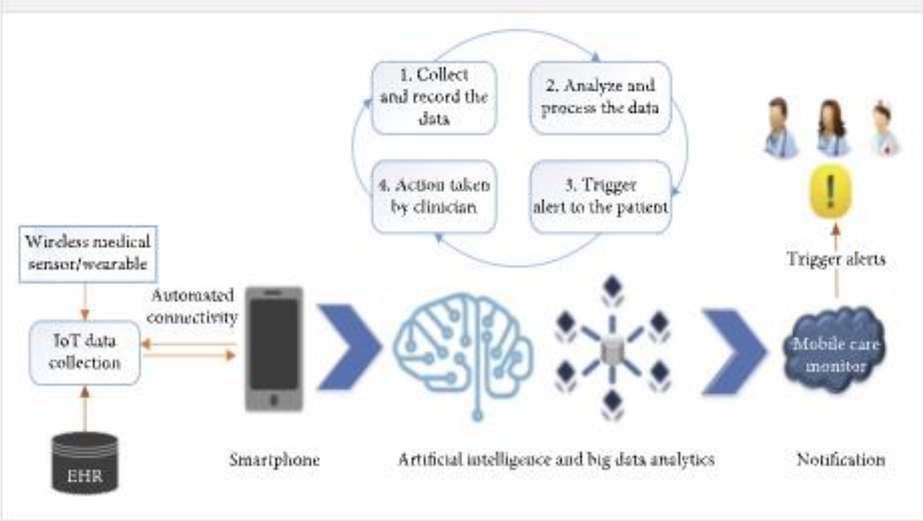

Fig. 4 m-health model with AI and DS

IV. Effectiveness of m-health using AI and DS

The suggested framework is made up of three key components: medical data collected from patients via mobile phones and telemonitoring equipment, an AI and big data analytics platform, and output to a mobile care monitor. Figure 5 depicts the proposed system's design. The combined AI and big data platform process the entire process of evaluating a large volume of data gathered from multiple sources in various forms. These are combined to give the impression of a real-time decision-making process. To examine the data acquired from a patient, various analytics concepts such as data mining and AI are applied.

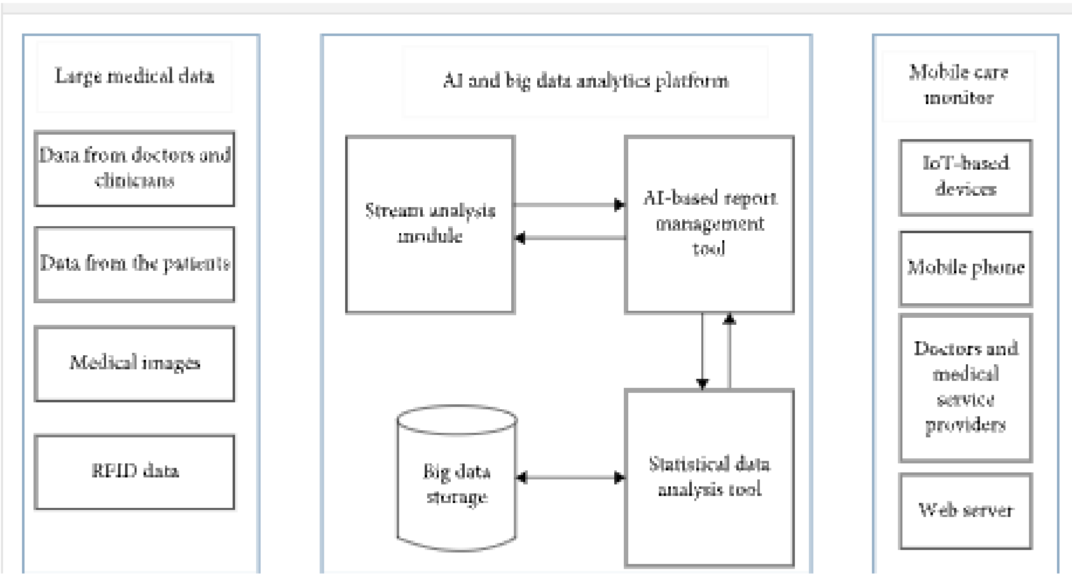

Fig. 5 Proposed AI and DS system

V. Conclusion and Discussion

Following conclusion can be drawn from the investigation:

- m-Health is a technique that employs mobile devices and technology for health interventions, and it is the most current technical breakthrough. Similarly, the use of AI and big data analytics in healthcare is regarded as one of the most significant successes for the intelligent healthcare system.
- A complete review of the m-healthcare system is proposed in this research, based on the use of AI and big data analytics. Various m-health benefits are offered as a result of this combination. All applications of key technology fields, as well as the building blocks of mobile health, such as communications, sensors, and computers, are presented in detail. The role of various machine learning tools in today's m-health model is also depicted. Future work should include a full evaluation of the retrospective validation of AI models and their combination with various digital health tools, as well as assessing their clinical validity and efficacy concerns on these systems.
- As clinical and medical systems grow, there will be an inevitable increase in their clinical use and implementation, which will lead to new issues. AIA aims to improve the quality of care by reducing clinician's error and decreasing their exhaustion arising from routine clinical activities and tasks. However, it may not reduce physician workload, as clinical guidelines might recommend that examinations be carried out more often for at-risk patients.

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