Individual Integration of Embedded Technology Enhancement with Internet of Medical Things (IoMT) Using Artificial Intelligence (AI)

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ABSTRACT

Artificial intelligence (AI) is a recent approach constructed on the science of computers that grows programs and algorithms to manufacture strategies intelligent and efficient for performing tasks that generally, require capable human intelligence. Technological advancements continue to alter our daily routines of human life. These advancements aim to simplify living and boost decision-making precision. AI Such intelligent structures streamline intervention in clinical diagnosis, medical imaging, and decision-making ability. In this era, the Internet of Medical Things (IoMT) develops as a next-generation bio-analytical device that associates network-linked biomedical strategies with a software application for healthcare. The medicine administration and treatment have radiofrequency identification (RFID) has been shown to be successful in monitoring and tracking. The voyage of the Internet of Medical Things (IoMT) is supported by the implantation of RFID chips in patients, which improves operational efficiency, boosts safety, helps with cost savings, and supports these goals. Human identity chips mostly use RFID, and its integration with AI technology will improve diagnostic precision and provide treatment recommendations for the patient.

This paper discussed on analysed the effects of AI and embedded technologies in human identity chips RFID. The report's key finding applications in contemporary healthcare are mostly driven by human identity chips' higher AI efficiency. The main obstacles to the adoption of AI and RFID in healthcare and other industries are issues with data and security, human safety, and the high cost of implementation.

Keywords — AI, RFID-Enabled IoT, IoMT.

I. INTRODUCTION

An Internet of medical things (IoMT) is a gathering of medical healthcare instruments and applications that attach to healthcare data technology systems through online computer networks [1]. AI embraces subsets of machine learning (ML)[2], Deep Learning (DL)[3],Conventional Neural Networks[4], Fuzzy Logic[5] and Speech Recognition[6] with unique capabilities and functionalities that can improve the performances of modern medical sciences. Medical devices prepared with Wi-Fi empower the machine-to-machine communication that is the basis of IoMT[7]. IoMT includes remote patient monitoring (RPM) for people with chronic diseases and long-term circumstances, pursuing patient medicine orders, and Computer systems that use artificial intelligence (AI) technology to simulate the functions of the human brain. Large volumes of labelled data are used to train AI systems, which then analyse the data to find patterns and correlations. These patterns and correlations are then used to develop prediction models. The ability of AI systems to be faster and more accurate than humans has created numerous opportunities across numerous industries.AI is expected to boost patient outcomes in the healthcare sector at a lower cost. Businesses and security information and event management systems set up to detect abnormal behaviour's and report the threat in real-time are some other industries that stand to gain significantly from AI technology[8].

Over the past ten years, radiofrequency identification (RFID) technology has become vital to the health industry. Implantable chips were given FDA approval in 2004 [9]. The technology has been around for a long, but its main application was to locate lost pets. Personal and medical data are stored in a database on implanted chips. Both the doctors and the patient have access to and control over the information. Tracking people with the chip implanted in their bodies is difficult because the device activates close to the scanner. AI and RFID technologies working together will improve the value and problem-solving skills.. The use of AI in healthcare services is intended to reduce errors brought on by human error in order to save lives. AI integration in embedded systems allows for real-time analysis of data from RFID chips and offers recommendations and insights that may be put to use. To increase the precision of diagnosis, these systems are desperately needed in the healthcare industry. In order to analyse the consequences of using AI and embedded systems in human identity chips in the healthcare industry,

II. METHODOLOGY

The secondary research model is modelled in this work. To establish applications and consequences of AI and embedded systems, particularly RFID in human identity chips, research findings from the literature are analysed and debated. The web databases were searched for central tropics surrounding AI and RFID to make sure that only pertinent literature is viewed. The subjects developed to address the focal question and cover pertinent publications include RFID technology, AI technology, AI and Embedded systems, and applications of RFID and AI in healthcare.

"AI," "RFID," and "healthcare" are used in different combinations to find "Patient identification," "Patient management," "Patient safety," "Patient monitoring," and "Drug compliance" may be used in combination. It was essential to read the paper's abstract after locating appropriate sources to ascertain whether or not they were related to the investigation.

III. FINDINGS

The distribution of publications by topic of interest is shown in the Theme & topics (see Table.1), with patient monitoring, improved diagnostics, data security, privacy, and technological aspects of RFID and AI among the topics that appear most frequently.

Table.1.Themes & Topics

Main theme	Topic	Year
Application of RFID in healthcare	Patient monitoring	2013-2016
	Patient tracking	
	Drug compliance	
	Patient identification	
Applications of AI in healthcare	Streamlined processes	2016-2018
	Improved decision making	
	Improved diagnosis	
AI issues and challenges	Data security and privacy	2018-2020
	technological	
	Financial or organizational challenges	
RFID issues and challenges with IoT and Blockchain	Data security and privacy	2020-2022
	Technological	
	Financial or organizational challenges	

A. RFID and AI applications for human identity

High human identity accuracy has many uses in many different sectors. RFID technology is essential in the healthcare industry to increase patient safety by decreasing human mistake rates. Human error is increased when healthcare workers interact with patients, but RFID technology is making it simpler and more accurate for staff to identify patients. Despite its potential, RFID technology has not yet been widely implemented in the healthcare industry because of its high cost [15]. The research that is now accessible indicates that RFID technologies have the following uses in the healthcare industry: gathering sensor-generated data, tracking assets and equipment, monitoring patients, identification and medication tracking, blood transfusion, identification, and administration.

Large datasets are processed by artificial intelligence to find patterns and correlations in the data. AI is capable of understanding the features of the data due to the training algorithm. AI was primarily utilized in the early phases of deployment to automate routine tasks and ease the transfer of information between medical facilities, patients, and insurance companies [10].

Applications of AI in healthcare include enhanced patient diagnostics, robotic surgery, boosting primary care services, and aiding clinical decisions. Important patient data can be stored on the RFID chips used for human identification. To effectively assess patients' real-time data, trained AI can be combined with embedded AI technology.

- **Identification of patients**

In the healthcare industry, the management of medical supplies, inventory, and assets has mostly been done through the use of RFID technologies in supply chains. Now that perception hurdles have been eliminated, RFID technology is being used to increase patient safety and satisfaction by giving healthcare providers a more precise way to identify their patients. RFID implant chips were given FDA approval in 2004 [9]. The patient's name, birthdate, allergies, medications, types of blood, and other information are all stored on the chip. Researchers have shown that RFID technology successfully addresses the rise in medical errors brought on by a need for identification systems (see Fig. 1).

Figure.1. RFID Chip X-ray.

By offering a platform where patient information may be accessible and accessed, RFID identification devices reduce patient handling errors.

RFID patient monitoring technology enhances patient safety by making it easier to track patients who are more susceptible. Preventing newborn snatching, tracking patients who are disoriented and monitoring elderly people who have been moving around for a long period are some of the tracking applications of RFID [12]. The tracking also reduces the amount of time needed for staff to find and recognize patients in emergency rooms. The possibility of saving more lives is increased by the rapid distribution of medical care. The technology also helps shorten hospital wait times.

- **Patient Tracking**

Keeping unnecessary hospital stays to a minimum is essential for effective resource management. The staff will be able to monitor patients who are prepared for discharge thanks to RFID tracking capabilities. Additionally, RFID chips create novel healthcare options. The management of infectious diseases depends on healthcare professionals' ability to track their employees, patients, and visitors [16]. RFID chips, for instance, can help identify and locate those who had contact with SARS victims in order to control the severe acute respiratory syndrome (SARS). To increase their safety, elderly people with chronic diseases can be tracked from their homes. The use of technology in mental facilities is also essential for tracking patients. The traceability of RFID chips boosts patient happiness and enhances general patient security.

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- **Monitoring patients**

Devices using the Internet of Things (IoT) technology gather sensor-driven data in real-time. IoT and RFID implant chips are integrated to provide real-time patient monitoring. Real-time patient information is generated via intelligent systems with RFID (see Fig. 2).

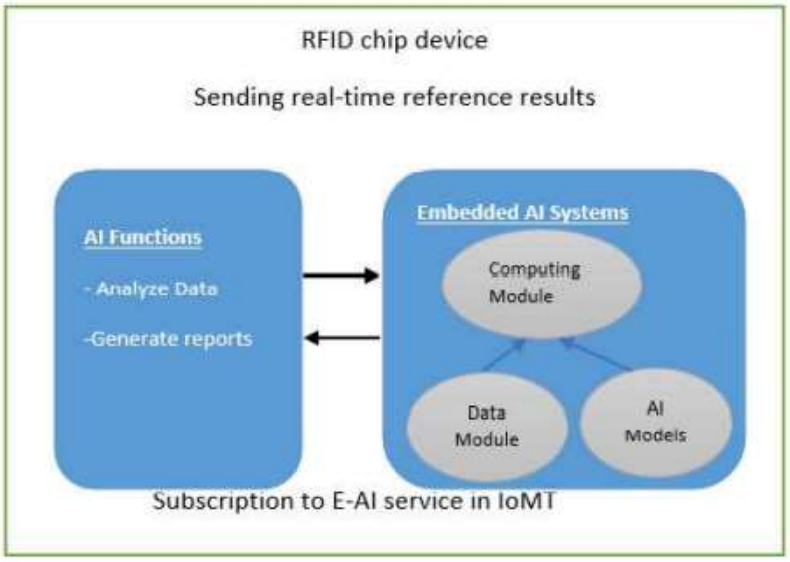

Figure. 2. E-AI System for RFID chip

The body temperature of the patient can be remotely observed by medical personnel. Chips with remote data links enable real-time transmission of patients' physiological information as well as their movements away from the hospital. Patients are monitored in real time so that staff members can decide on the best of action.

IoT devices provide a lot of data during the present e-healthcare transformation, creating new potential for enhancing quality, forecasting, and decision-making. IoMT is the general term used to describe this technology. RFID chips with embedded AI may evaluate collected data to find patterns based on training algorithms, which can improve decision-making in IoMT systems. Heartbeat irregularities and patient falls can be remotely monitored by integrating RFID technology with IoT systems. Monitoring older individuals with chronic diseases makes use of the technology. Patient monitoring is made possible by the real-time transmission of the data.

More sensors can be placed into the chip to track physiological processes and the surroundings of the patient. Data identified by the individual RFID chip is reported by smart systems. Artificial intelligence enables smart devices to communicate analysis of the data gathered or stored in the RFID database [14].The intelligent systems will be able to assess the physiological data that relates to the patient's environment and recommend for further actions

- **Integration of AI to improve decision-making**

More uses for RFID chips for human identity can be unlocked by combining AI and IoMT technologies. As the AI model develops with a variety of situations, IoT systems can learn from past choices (reinforcement learning) to forecast the future and perform better. Intelligent systems built into human identity chips will be able to "think for themselves" and make judgments about their own actions as a result of AI. The systems will analyse the information gathered and make health-related decisions for the patient [15]. The research states that healthcare organizations handle large amounts of patient data, rendering AI-enabled data analysis valuable and essential for better patient outcomes.

- **Patient compliance to drug**

RFID chips will increase patient medicine compliance by reducing the risk of medication error. The RFID and barcodes on the drug containers make sure the correct drug is given to the correct patient. The literature states that it is feasible to track a patient and determine the right dose for them by combining passive and active RFID tags [4]. The technology also makes it possible to remotely monitor patients' drug consumption. The smart systems notify the healthcare staff whenever the top of a medicine container is opened. The name of the medicine, the opening time, and patient information are among the details transmitted by the RFID.in terms of drug compliance, AI has created novel avenues.

According to several research, robots with built-in scanners can scan detect RFID implants and tagged tablet dispensers. The proper medication can be given to the right patient at the right time by robots [10]. Web-

based technologies and RFID technology can be combined to track drug use. The web-based interface alerts medical staff when a prescription medicine is about to expire.

B .Challenges related to data security and privacy

In the healthcare sector, personally identifiable information (PII) is gathered, archived, and analysed. Data confidentiality and privacy are not guaranteed by RFID technology. The risk of fake data exists for sensitive data stored in plain format on RFID tags. IoT solutions increase the risk of data transmission [12]. Sensitive data sent across unsecured connections can be intercepted by unauthorized users.

To secure the privacy of user data, there are numerous information security policies and rules. Among the regulations that address data security during the gathering, storing, processing, and transmission of personally identifiable information (PII) about healthcare include the Health Insurance Portability and Accountability Act (HIPAA) and the General Data Protection Regulation (GDPR). Storing medical records in plain format is against HIPAA requirements and may result in legal action, damage to one's reputation, and financial penalties. Timing, fault integration, and power analysis attacks are common against RFID systems.

Another risk related to data transmission in RFID systems is data spying. The information security concerns associated with RFID systems and chip implants grow when reader authentication requirements for RFID systems are not met [13]

- **Technology-related challenges**

The rapid deployment of RFID and AI technology in healthcare for human identity chips is limited by their limitations. The electromagnetic waves emitted by radiofrequency identification technology can cause electromagnetic interference (EMI) to other electronic equipment in the vicinity (see Fig. 3).

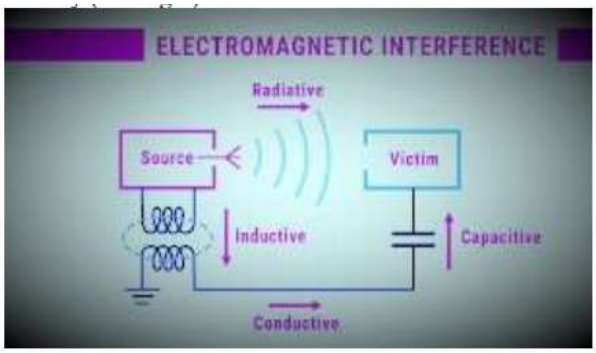

Figure.3. EMI effects on near by electronic devices

The utility of electric devices in the healthcare ,The RFID in human identity chips may affect medical equipment and other electronic biomedical devices. In a hospital setting, electromagnetic interference increases the risk to patient safety. Syringe pumps and external pacemakers are examples of automated medical equipment that can be affected by EMI resulting from RFID chips [16]. The patient's health and life are at danger when such important medical equipment is turned off by EMI

Reliability and accuracy problems are another technological concern related to the RFID technology used in human identity chips, as described in the literature. Barcode technology still has an advantage over RFID in terms of reliability despite the issues that RFID faces. In rare situations, RFID technology fails to perform as planned. Local magnetic interference, read distance, and rotation angle all have an affect on accurate RFID reading .

Therefore, RFID human identify chips cannot ensure a 100 % exact outcome. The literature illustrates the requirement for industry standards and recommendations for the use of RFID chips. This makes the adoption of the technologies by healthcare facilities more difficult. RFID technology is acknowledged to have privacy and security problems, which has created a demand for industry. There is a need for industry standards and guidelines for implementing the systems in the healthcare business due to the acknowledged risks associated with security and privacy implications of RFID technology.

Organizational and monetary challenges

For RFID and AI technology to be completely implemented in human identity chips, significant financial investment is needed. Even though the cost of RFID and AI technology has considerably decreased, it is still very expensive. The use of RFID technology to identify and track all of the personnel, patients, and assets in healthcare institutions will need a significant investment [16]. Healthcare facilities must invest in the supporting infrastructure for AI and embedded systems in human identity chips. Databases, middleware, application interfaces, and servers are a few of the infrastructure necessities. Staff training expenses, organizational change fees, business process redesign fees, and infrastructure maintenance fees are additional expenses associated with the deployment of technology. The current generation of medical professionals

are using traditional technologies, therefore they need to be more interested in implementing AI and RFID in human identity chips. Adoption of the technology is also hampered by practitioners' lack of preparation.

IV. DISCUSSION

The application of AI and embedded systems in human identity chips is portrayed as having two faces in the literature that is currently available. The arrival of technology can raise living standards. Technology in the healthcare industry offers an efficient solution for patient monitoring, patient medical compliance, and quick response, to name a few major areas [18]. Consequently, implementing the technology reduces human error in patient identification and diagnosis. The second aspect of utilizing AI and embedded systems in human identity chips is the difficulties associated with technology adoption in the healthcare industry. Three categories can be used to group the problems. The categories cover concerns with data privacy related to the technologies, organizational culture, and financial constraints.

Around 100,000 people every year pass away as a result of medical and clinical mistakes, according to data from the National Library of Medicine [17]. Misidentification of the patient or the drug is the main cause of medical errors. AI and embedded technologies in human identity chips can be used to solve this issue (see Fig. 4).

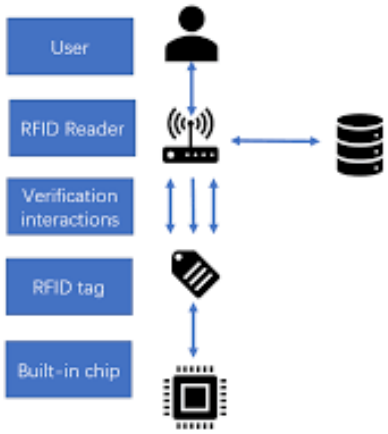

Figure.4. The Authentication workflow of RFID Smart

By reducing the chance of identification error, the technology increases patient safety. Despite the enormous potential of using AI and embedded technologies in human identity chips, adoption in the healthcare sector still faces significant difficulties. Sensitive data is gathered, processed, sent, and stored by the healthcare sector. The use of AI and embedded technologies in human identity chips has so been hampered by data security and privacy concerns. The use of technology can lead to better decision-making and overall workflow, as well as more accurate patient diagnosis. To fully utilize AI and integrated technologies in human identity chips, the supporting infrastructure must be compatible with the current IT systems.

First, to reduce the initial investment cost of the technology, low-cost smart systems must be created. Implementing effective security measures continues to be hampered by the low compute power of embedded devices.

V. Future Work And Technology Development

In the next ten years, as patient monitoring becomes more important, RFID sensor demand in the healthcare industry is anticipated to increase. There are still several IoT-based system study alternatives available to researchers, including wearability, security features, secrecy, real-time analysis, and training time requirements. Future chip less sensor research may concentrate on feature extraction, distance tracking, manufacturing, repeatability, and large-scale tag data collection. Training is required to raise medical professionals' understanding of the advantages of the technologies in enhancing patient safety.

VI Conclusion

From various angles, integrating AI and embedded technology into human identity chips increases patient safety. The technologies increase patient diagnosis, patient identification, and clinical decision-making. The use of technology in human identity chips improves safety by reducing the number of fatalities brought on by medical mistakes. Although technology in the healthcare industry has a lot of potential, adoption is quite low due to its high cost and high level of risk uncertainty. Adoption will become simpler if the security issues are resolved. A strong foundation must be provided by the existing literature to address security concerns with the use of AI and embedded technologies in human identity chips. Therefore, future research must address privacy issues that obstruct the use of the technology.

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