INDIVIDUAL INTEGRATION OF EMBEDDED TECHNOLOGY ENHANCEMENT WITH INTERNET OF MEDICAL THINGS (IOMT) USING ARTIFICIAL INTELLIGENCE (AI)

Abstract

Artificial intelligence (AI) is a contemporary approach based on computer science that develops programs and algorithms to provide innovative and efficient means of carrying out tasks that traditionally need sufficient human brains. Technological advancements continue to alter our daily routines of human life. These advancements aim to simplify living and boost decision-making precision. AI Very sophisticated frameworks simplify clinical testing, health imaging, and making decisions. The IoMT is a modern bio-analytical gadget that connects software for healthcare with network-linked biological techniques. Radiofrequency identification (RFID) has been found to be effective in keeping track of the delivery and treatment of medications. The implantation of RFID peripherals within patients enables the Internet of Medical Things (IoMT) achieve its goals of increased operational effectiveness, increased security, and cost savings. Most human identity chips utilize RFID, and their combination with AI technology will increase the accuracy of diagnoses and give patients treatment suggestions.

The impacts of AI and embedding techniques in RFID personal identification chips were examined and analysed in this study. The report's main result is that human identity chips' improved AI performance is mostly responsible for applications in modern healthcare. The biggest barriers to the adoption of AI and RFID in the medical sector and other fields include data and security issues, worries about people's safety, and the high implementation costs.

Keywords: AI, RFID-Enabled IoT, IoMT.

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I. INTRODUCTION

The term "Internet of medical things" (IoMT) refers to a collection of healthcare equipment as well as software programs that connect to medical information technology systems via online computer networks[1]. Modern medical sciences can perform better thanks to AI, which includes subsets of machine learning (ML), deep learning (DL), conventional neural networks (CNN), fuzzy logic (FL), and speech recognition (SR) [2–6].

Wi-Fi-enabled medical equipment enable the machine-to-machine access that is the foundation of IoMT[7]. IoMT involves pursuing individual medication prescriptions for patients, remote patient monitoring (RPM) for persons with chronic illnesses and long-term illnesses, and computer systems that mimic the activities of the human brain using artificial intelligence (AI) technology. 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. AI's capacity to do tasks more quickly and accurately than a human has created numerous opportunities across numerous industries.AI is expected to boost patient outcomes in the healthcare sector at a lower cost. Other sectors that stand to gain considerably from AI technology include businesses and security information and event management systems configured to detect aberrant behavior and notify the danger in real-time [8].

Over the past ten years technology using radiofrequency identification (RFID) has become vital to the health sector. 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 peripherals implanted in their patient’s 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. These systems are sorely required in the medical field to improve the accuracy of diagnosis. To evaluate the effects of using this technologies to human identification chips in the medical care sector

II. METHODOLOGY

The secondary research model is modelled in this work. Research conclusions from literature are analysed and deliberated in order to establish applications and repercussions of Artificial Intelligence and embedded systems, notably RFID for individual detection devices. The web databases were searched for central topics surrounding AI and RFID to make sure that only pertinent literature is viewed. The subjects developed to address the focal question and pertinent publications covers uses of AI and RFID in the medical care industry as well as AI and Embedded systems..

"Patient identification," "Patient management," "Patient safety," "Patient monitoring," "Drug compliance" are few of the combinations of "AI," "RFID and "medical care" that may

be employed. 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 order of distribution of articles by topic of interest is shown in Theme & topics (see Table.1), with patient monitoring, drug compliance, data security and technological aspects of artificial intelligence and RFID among the issues that appear 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	

1. **RFID and AI Applications for Human Identity:** High human identity accuracy has many uses in many different sectors. RFID innovation is essential in the medical care industry to increase patient protection by decreasing people 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 have the following uses in the medical industry: gathering data produced by sensors, tracking assets, monitoring patients, medication tracking and blood transfusion.

   Large datasets are processed by utilizing artificial intelligence to analyse data for patterns and correlations. 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 simplify information sharing between healthcare providers and patients, everyday tasks and insurance companies [10].

Applications of AI in medical care comprise enhanced patient diagnostics, robotic surgery, boosting primary care services, and aiding clinical decisions. Important patient data can be stored on the RFID device 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 providing an avenue via which patient data may be 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 new born 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 surveillance reduces the length of time needed for staff to find and recognize patients in critical 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 acute respiratory syndrome (SARS). To increase

their safety, elderly people with chronic diseases can be tracked from their house.The traceability of RFID device boosts patient happiness and enhances general patient security.

- **Monitoring Patients:** Devices using the IoMT technology collects data from sensors. in real-time. IoMT and RFID embed device are integrated to provide real-time patient monitoring. Real-time patient information is generated via intelligent systems with RFID (see Fig. 2).

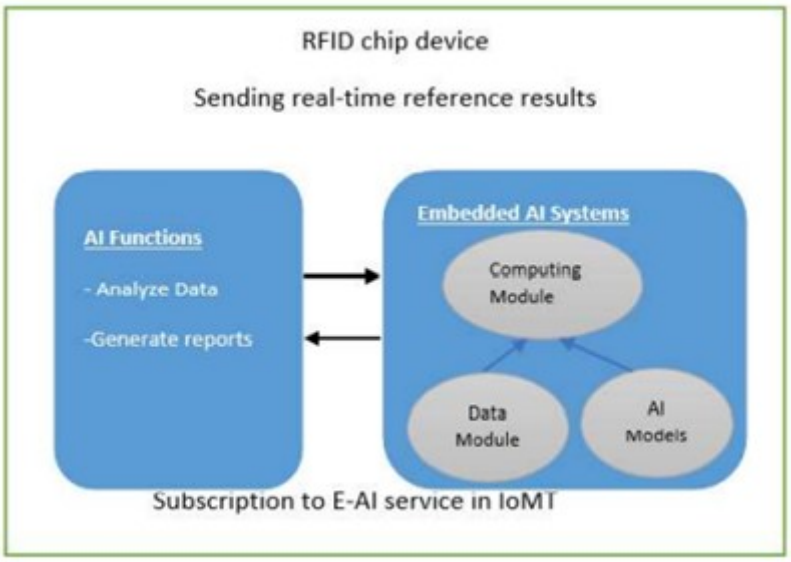

Figure 2: AI System in IoMT

The body temperature of the patient can be remotely observed by medical personnel. Patients' physiological data and movements outside of the hospital are sent in real-time possible by chips with remote data connectivity. 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. AI-enabled RFID sensors may analyze acquired data to identify trends using training algorithms, which can improve decision-making in IoMT systems. RFID and IoT technologies can be combined to remotely monitor patient falls and abnormal heartbeats. Observing older individuals with prolonged 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 information collected and kept in the RFID database [14]. The cognitive systems will be able to evaluate the physiological information related to the patient's environment and suggest subsequent steps.

- **Integration of AI to Improve Decision-Making:** Combining AI and IoMT technology will allow for further applications of RFID devices to protect human

identity. As the AI model develops with a variety of situations, IoMT systems can absorb from previous choices to forecast the forthcoming 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 collected and decide health-related making choices 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 risk of medication mistake. The pill containers' RFID and barcodes ensure that the exact medication is administered to the correct patient. Literature states that it is feasible to surveillance a patient and determine right dose for them by combining passive and active RFID tags [4]. The technology also makes it possible to remotely monitor patients' drug consumption. When the lid of a pharmaceutical container is opened, the smart systems alert the medical personnel. 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 perceive RFID implantations and labelled tablet suppliers. The proper medication can be given to right patient at right time by robots [10].

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

2. **Challenges in Data Privacy and Security:** In the medical sector, personally identifiable information (PII) is gathered, archived, and analysed. Data confidentiality and privacy are not guaranteed by RFID technology. Information that is sensitive put in simple format on RFID tags runs the danger of being faked. 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. 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 in healthcare for human ID device is limited by their limitations. The electromagnetic waves emitted by radiofrequency identification technology can cause other nearby electronic equipment with electromagnetic interference (EMI) (see Fig. 3).

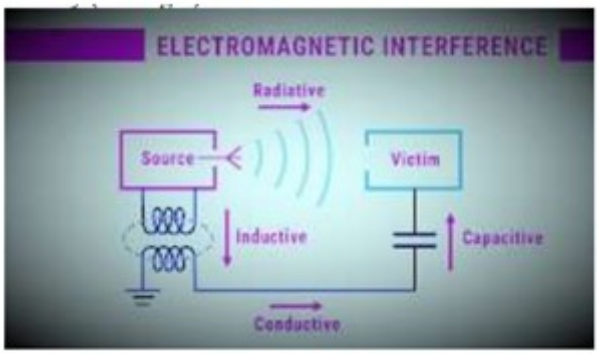

Figure 3: Electromagnetic Interference-EMI

The utility of electric devices in the healthcare, Medical equipment and other electronic biomedical devices may be impacted by the RFID in human identification chips.. In a hospital setting, EMI increases the risk to patient security. Syringe pumps and external pacemakers are examples of automated medical equipment that can be affected by EMI resulting from RFID chips [16]. When such crucial medical equipment is shut off by EMI, the patient's health and life are in trouble.

Another issue with the RFID technology utilized in human identity chips, as mentioned in the literature, is accuracy and reliability issues. 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.

Therefore, RFID human identify chips cannot ensure a 100 % exact outcome. Literature provides examples of the need for industry norms and suggestions for using 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. Due to the known concerns connected with the security and privacy implications of RFID technology, there is a need for industry standards and guidelines for adopting the systems in the healthcare industry.

- **Organizational and Monetary Challenges:** For RFID and AI technology to be completely implemented in human identity chips, significant financial investment is needed. Despite the fact that the price of RFID and AI technologies has decreased considerably, 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]. The infrastructure needed to enable AI and the embedded technologies in human identity chips must be purchased by healthcare facilities. A few of the infrastructure requirements include servers, databases, middleware, application interfaces, and others. Additional costs related to the use of technology include those for staff training, organizational change fees, business process redesign fees, and infrastructure maintenance fees. The current generation of medical professionals are using traditional technologies, therefore they need to be more interested in implementing RFID and AI in human identity chips. Adoption of the technology is also hampered by practitioners' lack of preparation.

IV. DISCUSSION

The application of AI in human identity chips is portray two faces in literature that is currently available. The arrival of technology can raise living standards. Technology in the health services industry offers efficient rapid reaction, patient medical compliance, and patient monitoring, to mention a few key areas. [18]. Consequently, implementing the technology reduces human error in patient identification and diagnosis. The challenges of adopting technology in the healthcare sector make AI and integrated technologies in human identity chips a second factor to consider. 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, the National Library of Medicine's statistics indicate [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).

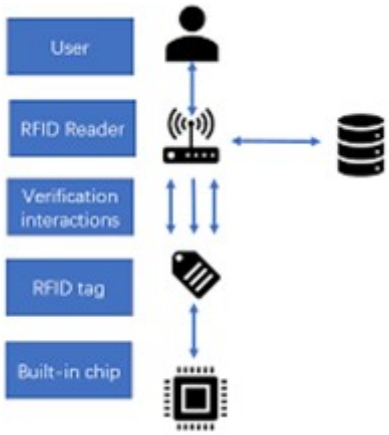

Figure 4: The Authentication workflow of RFID Smart

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

First, 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 EMPLOYMENT AND TECHNOLOGY DEVELOPMENT

In 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 Time requirements for training, secrecy, real-time analysis, and wearability of security features. 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 the advantages of technologies in enhancing patient security.

VI. CONCLUSION

From various angles, integrating technology into human identity chips increases patient safety. The technologies increase patient diagnosis, patient identification, and clinical decision-making. To use this technology device 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 huge cost and enormous danger and uncertainty. Adoption will become simpler if the security issues are resolved. The body of literature must be sufficiently robust to handle security issues with the application of AI and technology integration in human identification chips. Therefore, future research must address privacy issues that obstruct the use of the technology.

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