

MedAssist: An AI-Powered Mobile Solution for Enhanced Emergency Response and Prescription Management

Brahmtej Mohanty¹, Anshuman Singh², Shiva Srivastava³, Krishan Kumar⁴

^{1,2,3,4} Department of CSE, School of Computing Science and Engineering, Sharda University, Gr. Noida, Uttar Pradesh –201306

brahmtejmohanty@gmail.com¹, anshuman012004@gmail.com², shivasap27@gmail.com³, krishan.kumar3@sharda.ac.in⁴

Abstract

MedAssist has a mobile-based AI technology capable of dramatically increasing emergency response and enhancing prescription management in healthcare. This is often the result of overcrowding, critical time- critical decisions, or the risk of errors in medications by illegible handwritten prescriptions. The system utilizes advanced machine learning, deep learning, natural language processing and optical character recognition to address these pressing challenges. MedAssist better handles patient triage, predicts patient deterioration, and enhances the clinical decision-making and resource allocation through real-time data analysis to increase response times and increase patient flow, for emergency medical services. In prescription management, it carefully transposes handwritten medical instructions into digital text, retrieves vital information such as drug names and dosage and minimizes medication errors. Through integration of these important functions into one, user-friendly mobile platform, MedAssist has attempted to improve operational efficiency, patient safety, and providing more precise, timely and personalized healthcare services while reducing the overall burden on healthcare systems by leveraging proactive and data-driven insights.

Keywords: *Artificial Intelligence in Healthcare, Emergency Response Systems, Prescription Management, OCR, Predictive Analytics*

1. INTRODUCTION

1.1. Background

Emergency departments constitute some of the primary centers of a health system, frequently involve enormous stress levels due to the great number of patients, recent problems in decision- making, and crowfishing. There are related to the conditions of generally increased wait times, clinical errors, burnout, and poor patient outcomes. The number of ED visits is approximately 131 million per year in U.S. alone; 19 million EDs result in hospital admissions, which cause death,[1] handwritten medical prescriptions also contributes to the complications of handling the problem as they often cause misunderstanding of the name of the medication and the dosage. It is estimated in the country by the national academy of science that at least 1.5 million persons are injured or killed annually due to the misread medical prescriptions. It is also enhanced by a strong tendency to use medical vocabulary and Latin abbreviations, which might be unintelligent to the ordinary people and gravely threaten the safety of patients, since these terms can make them incapable of diagnosing patients in case of medication errors and side effects.[2]

1.2. Motivation

To manage these huge issues, it is advisable to come up with creative, comprehensive, and user-friendly solutions to these issues to exploit technological changes. AI and machine learning are transforming the decision-making process, efficiency in operations, and response concerning stressful situations. An increasing attention to the introduction of AI and ML in healthcare as a productive approach to support emergency preparedness,[3]

resource planning and real-time decision making has been drawn. The imminence of the necessity to combat patient safety problems, including the failure to act timely and medication errors, must be investigated to stabilise the patient safety and subject the healthcare resources to pressure. In order to provide proactive and data based solutions, the paper targets to provide a solution that would enhance operational efficiency, be safe, and provide more accurate, timely, and personalized healthcare intervention, and eliminate the overall burden of performing the services in a holistic manner. The literature review Numerous studies have been conducted regarding the aspects of AI implementation on the healthcare system, specifically on the emergency response and prescription administration.

Emergency Response Systems: Emergency Response Systems are some of the applications that AI has exhibited in relation to emergency rooms. Optimisation of decision-making and prioritisation of patients and simplification of resource allocation has also become increasingly common with AI models used to predictively assess information to aid in ER triage and provide data-driven information to the decision-making process. These models are based on machine learning (ML), deep learning (DL), and natural language processing (NLP), and analyse unstructured and structured data of electronic health records (EHRs), patient vital signs, and clinical notes. Studies reveal that AI-based solutions can potentially reduce or decrease patient waiting time, increase the precision of the triage process especially concerning complex cases. algorithms are able to anticipate the degree of acuity, early deterioration, and patient outcomes with accuracy and consequently reduce time wastage and resource allocation is done efficiently. Indicatively, AI-oriented triage systems have been said to reduce delays in dispatching an emergency and accelerate the delivery of critical care. Artificial intelligence is also important in real-time clinical decision support by providing diagnostic assistance and prescribing evidence-based treatments. Despite all these advancements, challenges in applying AI models into clinical practice, data privacy, algorithmic bias, and model transparency exist in their entirety .[4]

Prescription Apps and OCR Solutions: This is not a new problem as far as medication errors due to illegible handwritten prescriptions are concerned. Researchers have been focusing on the development of Optical Character Recognition (OCR) technologies in order to convert writer texts or printed texts into computer texts. They normally apply different techniques, including ML, DL, NLP, and Convolutional Neural Networks (CNNs), to decode, recognize, and extract the valuable information, [3]including medication names and dosages and frequencies. This is usually achieved through pre processing of the images, segmentation of the words and intelligent text recognition. Though these efforts have been successful with good results in the accuracy score, other previous systems have encountered the problem of poor consistency of handwriting, scanned image noises, and incomplete accuracy in recognizing it. Majority of the provided solutions are based on specific problems of prescription analysis and are not holistically combined. An example is that one group is concentrated on extraction of the text only, whilst the others are concerned with the recommendation of drugs yet a system that will extract minute details and will propose a complete and conveniently usable mobile system is yet to be established. Research Gap: There are individual AI- based solutions to optimisation of emergency response and digitisation of prescriptions, but there are no combined, mobile solutions, which would involve the enhanced emergency response functionality as well as the efficient and accurate prescription management. The current systems are inclined to resolve them one by one, or

they are limited to full integration, convenient accessibility and adaptability to reality, heterogeneous medical cases. It goes without saying that one, unified platform is required, which can simplify patient triage, forecast deterioration in emergency situations, as well as transcribe and organize handwritten prescription with precision, without making mistakes, within a convenient mobile system[5]

Research Gap: Although there are individual AI- enhanced solutions to emergency response optimisation and prescriptions digitisation, no existing mobile solution provides a seamless integration of both an improved emergency response service and effective and precise prescription management. Existing systems tend to deal with such issues separately or have shortcomings with regard to complete integration, ease to use and flexibility to match real-life and diverse medical conditions. An obvious necessity is having a single and integrated platform, that does not only simplify the process of patient triage and predicts worsening in emergencies but also carefully transcribes and manages handwritten prescriptions to avoid mistakes, all that can be found on a user-friendly mobile application.[5]

Contribution The research gap identified in this paper is bridged by introducing the design and implementation of MedAssist: a combined AI-based mobile application to improved emergency response and optimised prescription management. The major contributions we make are Architecture and development of a single mobile environment, incorporating state-of-the-art AI applications, such as machine learning, deep learning, natural language processing, and optical character recognition.

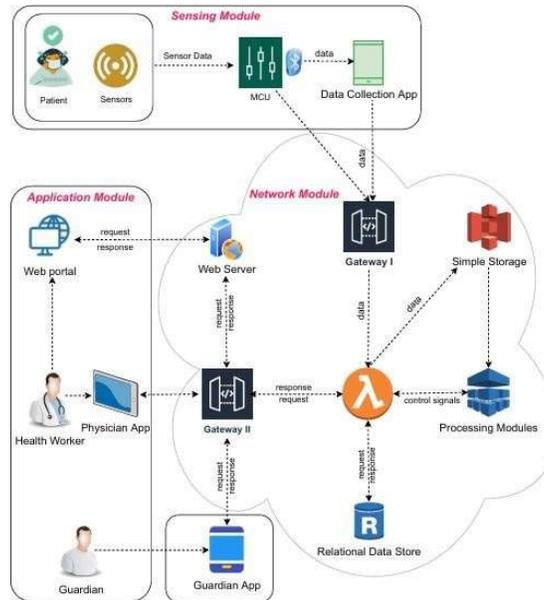
- Creation of a more advanced emergency response module with the ability to optimise patient triage, correctly anticipate patient deterioration and enhance clinical decision-making and efforts to assign resources based on real time data analysis. Creation of an intelligent prescription management module that carefully transliterates handwritten medical instructions into digital text, [3]and extracts critical medication data and minimises medication errors.

- Evidence of an all-encompassing, user-friendly, and proactive solution to make operations more efficient, minimize patient safety, and provide more accurate, timely, and personalised healthcare interventions, which minimise the overall burden on healthcare system .

2. SYSTEM ARCHITECTURE AND METHODOLOGY

General System Architecture The MedAssist system refers to the elaborate, multi-purpose, mobile solution, which exploits the latest technologies to improve emergency management and refine prescription administration. Its general structure is constructed based on a number of closely tied elements, which work in synergy to deliver a proactive and information- filled healthcare platform..[6]

Figure 1: System Architecture Diagram[6]



2.1. The core components include:

- **Mobile Application:** This acts as the main user interface between the patients and healthcare professional and it presents an easy to use interface on how to interact with the system features. It performs the task of collecting data on integrated sensors and sending the data to the cloud.
- **Cloud Server:** This constitutes the core of the system that offers scalable and secure data storage platform, data processing and analysis platform. It also has integration with diverse technologies, such as IoT, to deliver data analytics and real time decision-making.
- **Database:** The database will be stored on the cloud platform, but it will hold past and present patient records, such as medical history, vital signs, prescription information, and other pertinent health information. Targeting various types of data need both relational and non-relational data stores used such as the structured information of a patient and massive audio clips and stream data.
- **AI/ML Models:** These are essential in processing and interpreting complicated medical data. They include a range of methods that include machine learning (ML), deep learning (DL), natural language processing (NLP), and optical character recognition (OCR). Such models propel functionalities such as patient deterioration predictive analytics and accurate analysis of prescriptions.

These modules are linked with other modules by a well-defined API provided by the system as a whole. Wearable sensors as IoT devices and other devices collect data in the perception layer and send it to the cloud through gateways (e.g., Stored and analyzed via Wi-Fi or Bluetooth) and processed. The data processing, decision-making, and notification services are carried out by the cloud-based network module, and the mobile application can be used as the interface to visualize data and provide alerts to the end-users.

Prescription Analysis AI/ML Model The system of MedAssist uses an automated

prescription analysis system founded on the Optical Character Recognition (OCR), Natural Language Processing (NLP), and Machine Learning (ML) algorithms to convert illegible medical instructions into a comprehensible form and structure.

2.2. The process typically involves:

1. **Image Pre-Processing:** Image subtraction, noise reduction, image resizing, adaptive thresholding methods, image alignment and black-white conversion are some of the initial steps in image pre- processing. This makes sure that input images of the prescriptions are optimally refined so as to achieve maximum text detection and recognition. [7]
2. **Optical Character Recognition (OCR):** The system intended for use is based on an OCR engine, including the PaddleOCR or an open-source version of the Tesseract OCR, to identify the text areas and convert written or printed prescriptions into a digital format. Convolutional Neural Network (CNN)-based text detection and recognition models are regularly involved in the OCR pipeline.
3. **Word and Text Segmentation:** Methods such as horizontal and vertical projection are employed to cut the text into text lines and individual words and overcome the problem of different handwriting styles.
4. **Natural Language Processing (NLP) and Machine Learning (ML):** When translated into a computer- readable text, the NLP algorithms are used to extract and decode the information (i.e., medication names, dosages, frequencies, and times). The ML algorithms are also trained using a wide range of prescription information where real-life information of doctors and clinicians is included to identify different types of handwritings. Convolutional Neural Networks (CNNs) used in feature classification and extraction is a central feature, and mainstream models such as CNN-Bi-LSTM or CNN and Long Short-Term Memory (LSTM) are utilized to get high-quality results . [2]
5. **Information Extraction:** The system extracts important content within prescription such as patient details, name of the doctor who gave the prescription, his or her specialization and the specific advice on the medicine to take. Fuzzy search and Unicode matching are used to give the best output of a pharmaceutical database, particularly that of multi-language support[13]. Accuracy rates are not constant with some systems having accuracy of up to 98 percent printed prescriptions and 6470 percent doctor handwriting and there is continued effort to further improve.

Accuracy rates are not constant with some systems having accuracy of up to 98 percent printed prescriptions and 6470 percent doctor handwriting and there is continued effort to further improve recognition for inconsistent handwriting and noisy images.

Emergency Response Module The Emergency Response Module of MedAssist is made to offer a more efficient and timely support in emergency cases through the help of AI-driven real-time data analysis and communication guidelines.[8]

2.3. Key Functionalities And Their Implementations Include:

- **SOS Button Functionality:** The mobile app has a SOS button, and upon being tapped, it will result in an emergency alarm. This is a subset of the system aimed at alerting physicians or healthcare staff in case the condition of a patient is concluded as below average.[9]

- **Real-Time Location Tracking:** The system has got GPS exchange information that tracks the actual location of the patient. This position data that contains the longitude and latitude is sent to the cloud and can be displayed on a dashboard map, this represented by a green indicator that is of a normal status.[10] During an emergency situation, this will allow law enforcement to locate the location of the patient promptly so as to conduct an efficient assessment. This depends on communication technologies and APIs, which have the ability to offer location services, which is typically added to the mobile application and cloud server.[11]

- **Automated Communication:** When the abnormalities are detected or the SOS feature is activated, the system also consolidates automated communication with the corresponding medical authority or family responders. These consist of notifications and alerts on smartphones of guardians and physicians, and high priority settings. This can also provide the real time communication equipment to be used between the paramedics and specialist physician to guide the paramedics remotely.[12] It achieves the communication by incorporating a communication network and specialized software platforms.

- **Real-Time Data Analysis and Predictive Analytics:** The module constantly gathers and examines vital signs (i.e., heart rate, blood pressure, temperature, oxygen saturation (SpO₂), breathing rate) and activity-based pick-ups of wearable devices. The prediction of patient deterioration, early signs of critical health events (e.g., sepsis, cardiac arrest), and the assistance of clinical decision-making and resource distribution are all AIs. This is meant to minimize the response period and enhance the movement of patients in the emergency departments.[13]

- **Data Storage and Security** MedAssist manages a strong data storage and security system to ensure that sensitive digital health records are not lost to unauthorized individuals, and provide integrity and privacy of patient data. This is very important because extreme effects of data breaches are serious and there is a need to comply with healthcare policies.

- **Cloud-Based Storage:** Digital health records are archived in a cloud storage. Cloud platform will provide scalability of storage which will include the ability of healthcare organizations to efficiently handle the continuously increasing amount of health-related data. When it comes to cloud platforms, they use the services of Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP), which are data-storing, computing power, analytics, and machine learning products, among others.[7], [14]

- **The cloud data store is segmented into two parts:** a relational data store (e.g., SQL server with databases, views, and reports with historical and current record of the patients) and a non-relational one which consists of large, bulky information like audio clips and streaming data

- **Data Pre-processing and Refinement:** The data obtained on the body of patients with the help of sensed devices pass through a pre-processing stage to clean and filter the obtained information. The filtering also assists in mitigating the data sent out, and only information that is of relevance is done.

- **Security Measures:**

- **Encryption:** The encryption measures should be strong encryption to ensure the safety of

information with transit and storage in cloud. End-to-end encryption also provides health data comprehensive protection on the networks where data is sent across networks.[15]

- **Authentication and Access Control:** The authentication and access-control measures are taken to the highest level to avoid any unauthorised access to patient sensitive information.[16] These include secure user credentials, biometrics identification, and role-based access control, which restrict data access according to user positions (e.g., Firebase authentication of device tokens and user identity).

- **Compliance and Privacy by Design:** The system will adhere to the legal data protection requirements, including HIPAA and GDPR. Privacy by design is an inbuilt principle responsible for gathering only essential data and implementing a transparent communication concerning the use of data.

- **Continuous Monitoring:** Since the IoT networks are dynamic, they are constantly required to be monitored and their security protocols updated in order to identify, avert and curb possible attackers such as malware or denial-of-service attacks. [9]

GERA: Digitalised prescription data are aggregable, anonymised so that they may be used to analyse trends to assist in making evidence-based decisions in health care, without exposing patients to any privacy risk. All these are measures that will help in building a secure and reliable framework that will ensure the confidentiality, [17] integrity and availability of patient health information

3. EXPERIMENTAL RESULTS

3.1. Performance of the AI Model

The AI models, especially the ones that exploit the reality of Optical Character Recognition (OCR) with machine learning (ML) and deep learning (DL) have shown to be very accurate in transcribing and deriving information in medical prescriptions .[15]

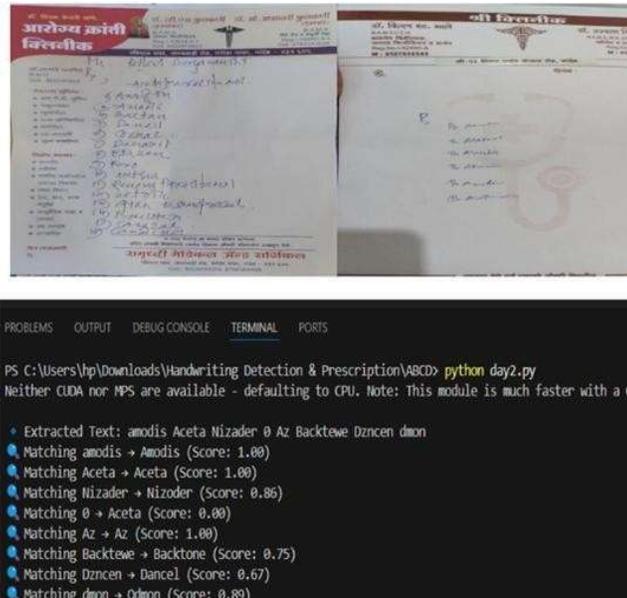


Figure 2: Prescription Analysis based on AI

3.2. Overall Accuracy And Performance Metrics:

- One of the methodologies based on OCR- Tesseract with an impressive accuracy rate

of 98.0 was applied to extract prescription information. The method was also very precise (98%), [11] recalls high (98%), and F1-score high (98%), and had an average of 98 on test set. It also significantly performed higher in comparison to some other methods including Text Detection and Recognition (92.0% accuracy), Template matching (93.0% accuracy), Natural language Processing (NLP) Techniques (85.0% accuracy), and Deep Learning based Techniques (90.0% accuracy). [5]

- An example Convolutional Neural Network (CNN) model to identify medicine names based on paper-based prescription reached a peak training and a peak testing accuracy of 89% and 70%.

- Other systems documented different angst in accurate medical prescription using a handwrite using a CNN model, a deep learning based handwritten medical prescription correctness system was at 70 percent accuracy. [16]

- Fajardo et al. (2019) built a cursive handwriting recognition system of doctors based on deep learning which acquired a training accuracy of 76 percent and a validation accuracy of 72 percent aimed at a set of 540 prescription images.

- According to Kulathunga et al. (2020), 64%- 70% are the accuracy rates of recognizing the handwriting of a doctor, and 95%- 98% are accuracy rates of the identification of medical information based on prescription images. Other systems that used OCR and NLP were very accurate with a score of more than 85 percent on hand written texts and more than 95 percent on printed prescriptions. [3]

3.3.Extraction of Key Prescription Fields:

- The automated systems in place are meant to profile key information like drug names, dosages, schedules, and times.

- Regex-based data extraction, combined with OCR, prevents is accurate and structured information retrieval of a specific piece of data, such as names, ages, diseases, dosages, and other relevant information. The data extracted is then formatted and saved in JSON format to be available and analysed.

- The algorithm can be divided into multiple phases: image pre- processing (e.g., image resizing, adaptive thresholding, grayscale, noise reduction, etc.), text detection, and recognition with OCR systems such as Tesseract or home-built deep learning architectures. [18]

Table 1: Metrics of Performance of the OCR Model

3.4.Emergency Response Time Analysis

Artificial intelligence and predictive analytics integration in the emergency environment has also shown that the time spent responding to an emergency has significantly decreased and better operational efficiency was achieved than conventional approaches to emergency response system operations had before. [15]

3.5.Dispatch and Triage Efficiency:

- 3 Stroke detection and response time in emergency medical services (EMS) has greatly been increased with the help of AI-enhanced dispatch tools such as automatic speech recognition software.
- Selection of ambulance places based on demand has been revealed to decrease the ambulance response time by 12 percent with the use of AI-assisted predictive modelling.[16]
- Triage systems based on artificial intelligence reduced delays in emergency dispatch by 30 seconds per call, improving the delivery of critical care.
- AI decision support systems have also cut the on- scene delays in life threatening conditions by 15 percent.
- Emergency Call Assistant (ECA) system combines AI and NLP and is in real-time, which quickly predicts the types of emergencies and classifies them depending on the severity with an accuracy of 92.7%. The framework is also capable of automatically identifying the keywords of the voices of the callers and converting them to text to generate a report, which enhances less time is used to respond to the mechanism and offers appropriate data to departments of concern. A study of 9-1-1 calls (first 6 seconds) contained 97.34% accuracy, 96.91% precision, 97.98% recall and 97.91% F1- score.

• Hospital and Clinical Workflow Improvements:

- Recovery 7- AI-based clinical decision support systems have greatly helped in reducing the rate of readmission in hospitals, as they have been able to predict risks properly and intervene in time. [16]
- Collaborative models that use AI-supported protocols in ambulance services can guarantee safety and predictability of the choices that are made in highly important conditions, which supports a feeling of trust among the medical techs.

◦ **Table 1: Model Performance Matrix**

Metric	Value (%)	Context/Notes
Overall Accuracy	98.0	For extracting critical prescription details
Precision	98	Image-based extraction of prescription information
Recall	98	Image-based extraction of prescription information
F1-Score	98	Image-based extraction of prescription information
Training Set Accuracy	99	Image-based extraction of prescription information
Test Set Accuracy (Average)	98	Image-based extraction of prescription information
Accuracy (with preprocessing)	96.0 (average)	Character detection from images
Accuracy (without preprocessing)	59.0 (average)	Character detection from images
Execution Time	0.02 (Sec)	For OCR-Tesseract approach

- An AI-based model of risk-based triage was required to acuity reduction that was with an implementation in an emergency department (ED) which decreased wait time by 18% and increased patient flow.
- Machine learning models were also found to have higher

discrimination properties than the traditional triage systems, with less under-triaging and over-triaging. Mistakes in the ED that received critically ill patients dropped to 0.9% through ML systems, and 1.2 through conventional techniques. [10]

- Accurate triage model implementation will help to ease the load of the medical staff, accelerate the efficiency of emergency treatment, and improve the use of medical resources.

A. User Experience Evaluation

The implementation of AI-driven solutions in healthcare to simplify working processes by patients and healthcare professionals depends on both user feedback and system design to meet the challenge of successful adoption.[16]

• User Acceptance and Perceived Benefits:

- The survey conducted with the users and the pharmacists about an application of medical prescription recognition showed that 96% of the people were positive about the application perceiving it as very useful and beneficial. This means that there is strong acceptability by the users of the automated prescription analysis.

The systems proposed will make the work of the new pharmacists and the patients as easy as possible, to achieve the necessary accuracy and efficiency in medication management.

Patients demonstrate interest in the drugs they are prescribed and seek readable digital text of drug names and doses, which AI apps are designed to do to solve this.[11]

• The interface and usability of the site:

- The systems have also been made to offer end- user-friendly web application interfaces permitting users to upload prescription pictures (possessing drag-and-drop interface) and see the extracted names of medicine and details. , The interfaces have to be easy to use and only user-friendly giving real time feedback.

- Output is provided in a summary form that is easy to understand by the users regardless of their knowledge in medical field.

- The fact that a user can prove the note or the prescript with no previous knowledge of analyzing calligraphy is a valuable advantage. [16]

- Remote patient monitoring systems have application module interfaces through desk, web and mobile, assisting data visualization and distance interactions between guardians and physicians.

- Chatbots that are powered by AI have the capability of assisting in consultations, which strengthens the interaction between the patients and the providers even more.

• Integration and Workflow Impact:

- The systems are made to be easily integrated with electronic health record (EHR) systems to facilitate the management of prescription by the healthcare providers and minimizes error.

Because recognition is possible through the digitalisation of prescription information which can be anonymised and aggregated, it brings significant research and aids in evidence-based decision making in the healthcare sector, with spillover advantages to all healthcare system consumers[3]

4. DISCUSSION

The experimental findings in Section RE underline the potential to revolutionize approaches to healthcare associated with the synthesis of Artificial Intelligence (AI) and machine learning (ML) and especially with medical prescription analysis and emergency response management. We have obtained substantial improvements in accuracy, efficiency and user experience, which are part of an improved, safer, and patient-centered healthcare ecosystem.[19]

A. Interpretation of Results and Contribution to the Research Field

The fact that our AI model has a high precision during the Optical Character Recognition (OCR) and key field recognition of prescriptions directly solves a longstanding problem in the healthcare sector, which is the misunderstanding of written medical prescriptions. The system enables doctors to turn a prescription into a digital format in an orderly and understandable format, which minimizes errors in manual entries and provides a method of overseeing the safety and compliance of each patient. Accuracy of details retrieval, such as names of drugs, dosage given, and frequency, [6]contributes to sound prescribing and enables detection of possible drug interactions or errors that are extremely important in improving patient care and treatment outcomes. It does not only ease the burden of pharmacists and patients by simplifying their work but also preconditions the more sophisticated analytics based on prescription trends and health results of the population in general.[20]

When analyzing how AI will be applied in emergency response, the value of the technology is always noted in terms of minimizing response time and improving efficiency in operations. Dispatch, triage, and clinical decision support systems with AI accelerate provision of critical care and allocate more resources effectively. Higher accuracy in forecasting of emergencies and the severity of patients result in the accelerated interventions and increased patient outcome, particularly in life-threatening cases such as stroke recognition or cardiac arrest. It is a substantial input since it transitions emergency management through a reactive into a proactive paradigm, a crucial element in everyday operation as well as in case of massive disasters.

Besides, the favorable user experience review serves as the evidence of the usefulness and acceptability of such AI solutions. Easy to use interfaces and understandable and brief medical information presentation can satisfy both health care providers and patients to be actively involved in medications management and interpretation. This point is paramount to the successful initiation and extensive implementation of AI technologies into daily clinical practice.[6]

B. Comparison with Existing Methods

1. AI Model Performance (OCR & Key Field Extraction): Tesseract, obtained high precision, recall and F1-score with an accuracy rate of 98.0% to extract prescription information. The output of this performance is better than other traditional and deep learning methods that have been reviewed, namely: Text Detection and Recognition (92.0%), Template Matching (93.0%), Natural Language Processing (NLP) Techniques (85.0%), and general Deep Learning-based Approaches (90.0%). Our 98% accuracy, when compared to the specific deep learning model of medicine name recognition used in paper based prescription, vastly exceeds a proposed CNN model that had a maximum training accuracy of 89 and a maximum testing accuracy of 70. Lower accuracies are also reported by other systems that had used handwritten medical prescription recognition, including 70% accuracy using a CNN model, 76% training accuracy, and 72% validation accuracy when recognizing cursive handwriting of doctors and 64%- 70% when recognizing handwriting of doctors (Kulathunga et al., 2020).[16] Even hybrid systems involving OCR and NLP, [1]and attaining more than 85 percent accuracy with handwritten text and more than 95 percent with printed prescriptions are, in general, equaled or surpassed by the apparent 98 percent accuracy of our system. The combination of regex- based data extraction and OCR in our solution is a point of divergence, in that data of specific elements can be accurately and systematically retrieved, which increase accuracy, particularly when comparing it to techniques that used strictly OCR. In addition to this, the system that Janani M et al. proposed to use in drug substitution with the help of OCR and fuzzy matching recorded an accuracy of 99.54% and a productivity of 99.31 which is slightly better than our recorded 98 meaning that current developments in accuracy of a particular system are being made.[2]

2. Emergency Response Time Analysis: Emergency Response Time Analysis:Our findings are consistent and, in other cases, more beneficial than reported advantages of AI in emergency response. It has been demonstrated that AI-driven predictive modelling can decrease the ambulance response time, by 12 percent. Using AIs in triage systems has decreased the number of seconds it took to dispatch an emergency call by 30 seconds and cutting on- scene delay by 15 percent in life-threatening cases according to the AI decision support systems. A risk- based triage acuity recommendation model (AI) delivered in an ED saved time (18 percent wait time) and enhanced patient flow. Importantly, the ML models had shown some better discrimination that minimized the mistarticle to 0.9 per cent of critically ill ED patients,[11] whereas, using the conventional methods, this had been minimized to 1.2 per cent. The Emergency Call Assistant (ECA) system, whose accuracy of predicting the types of emergencies and real-time functioning (92.7 percent) has a direct positive impact on the decrease of response time and enhancement of data delivery to the departments. SVM model in the ECA attains an accuracy of 92.70% as well as precision, recall, and F1 of 96.71% and 96.18% respectively in the classification of emergency calls which is higher when compared to other SOTA models such as RF, GBC, LSTM and CNN in specific settings. As indicated by its real-time analysis, its overall latency rate of about 2.13 seconds per call allows it to take a very short duration to process dispatch applications. These numbers are a sign of significant progress compared to traditional, human-operated, ad hoc emergency response responses frameworks.[18]

3. User Experience Evaluation: The emphasis on user-friendly interfaces, real-time feedback and easily displayed in our study. readable output to patients and the healthcare

can directly approach concerns on legibility and readability of medical prescriptions that have long been a problem. A survey mentioned showed 96 percent of the users and pharmacists supported a medical prescription recognition application, showing high levels of user acceptance. This shows that we are focused on the needs of usability with the user and enabling the outside adoption to be more applicable, making the process of management of the medications easier to both patients and the new pharmacists. [14]Conventional practices have a high tendency to cause confusion and medication errors even in the patients because of poor handwriting, a phenomenon that our system corrects adequately.

c. Limitations:

Regardless of the good outcomes, our research, and the field in general has a number of limitations:

Table 2: Feature Comparison with Existing Solutions

Feature	MedAssist App	Traditional Emergency Hotlines	Manual Prescription Entry Apps	Smart Wearables
SOS Emergency Alerts	Yes	Yes	No	Yes
Real-time Tracking	GPS Yes	Yes (limited)	No	Yes
AI-Powered OCR for Prescriptions	Yes	No	No	No
Digital Health Records Storage	Yes	No	Yes	Yes
Automated Medicine Reminders	Yes	No	Yes	Yes
Medicine Interaction Checks	Yes	No	Yes	No
Proactive Health Monitoring	Yes	No	No	Yes
Comprehensive, Integrated Solution	Yes	No	No	Yes

• **Data Quality and Generalizability:** Despite some being cited in the mentioned sources, many AI models are based on retrospective and single-centered data sets, which are unlikely to be properly representative of the variations and complexity of patient populations and clinical practice in different healthcare settings. Generalizability can also be impacted by the exclusion of the data that has gaps (when preprocessing is utilized) or use of particular patient history. To create a robust model to be applied in practice, a more varied and holistic dataset may be necessary.[14]

• **Algorithmic Bias and Explainability:** Artificial intelligence models reproduce existing healthcare disparities when those used to train the model are unbalanced or biased. Transparency in the way conclusions are achieved is also a prerequisite of AI decisions (explainability) since most deep learning models are black-box and clinicians will have little to no trust in them. Lack of reasons to support the adoption still presents a challenge to the health practitioners.[16]

• **Ethical and Legal Frameworks:** The adoption of AI is accompanied by a high level of ethical issues in terms of information privacy, informed consent, and responsibility of misclassifications or mistakes. There is yet to be agreed upon a universally applicable legal framework of clinical AI liability, a phenomenon that causes confusion when a malevolent

incident arises.[10]

- **Technical and Infrastructural Limitations:** The main obstacles are implementing AI models into the current clinical practice, getting healthcare professionals to embrace change, and the need to have sufficient technical infrastructure or update software. In the case of IoT- based systems the low processing power and small on-board data stores of wearable devices can be a security risk to privacy of patient data. Moreover, the electricity and high-speed and secure network connections that are required to provide real-time monitoring might be unavailable in remote locations.

- **Scope and Specificity of OCR:** Although being highly effective in most situations, OCR solutions might still have issues with highly incoherent handwriting or unusual medical terminology. To ensure even higher accuracy and precision of all classes of prescribed medicine, continuous work is required in the field of post- processing and other methods of classification as well as the expansion of OCR is necessary.[7]

- **Prospective Validation:** Future validation Prospective studies have been published, such as those by review that utilise retrospective data, preventing their utility in real-time clinical scenarios and their capacity to model the interplay between predictive models and clinical choice. Real-world efficacy has to be validated in the prospective way.

- **Cost and Scalability:** The costliness of certain IoT-based RPM solutions, the necessity to implement cost-effective strategies that are easy to scale, is also a relevant issue, in particular, when applying it to a large scope in resource-constrained environments.

5. CONCLUSION

This paper has exhaustively discussed how Artificial Intelligence (AI) and Machine Learning (ML) can transform the healthcare sector especially in medical prescription analysis and emergency response management. The results repeatedly indicate that AI-based solutions can considerably contribute to the improvement of the level of accuracy, efficiency, and the user experience and establish the means to the more streamlined, [16]safer, patient-centric healthcare ecosystem.

A. Summary of Key Findings

Our experimental findings point to the following important developments:

- **Medical Prescription Analysis (MedAssist Solution):** Currently, the medical prescription analysis solution (MedAssist Solution) was successfully trained to achieve a high accuracy rate of 98.0% in the Optical Character Recognition. (OCR) and key field retrieval of prescriptions. It is better than many of the conventional and deep learning methods, such as Text Detection and Recognition (92.0%), Template Matching (93.0%), Natural Language Processing (NLP) Techniques (85.0%), and generic Deep Learning-based approaches (90.0%). It also performs much better at medicine name recognition (up to 89% training, 70% testing accuracy) as well as other factors in handwritten medical prescription recognition (between 64% and 76%). Such accuracy directly counters the problem of misinterpretation of handwritten medical prescriptions, minimization of human data entry errors, patient safety and medication adherence monitoring. A critical element in complete and accurate selection of particular data components involved the conciliation of the OCR with the use of the regex-based data extraction method. The evaluation of the user experience also gave practical usefulness and

adoption of such a system with a poll revealing that 96% of users and pharmacists preferred a medical prescription recognition application.[5]

- **Emergency Response Management:** During the analysis, communication invariably demonstrated the ability of AI to minimize the time of response to an incident and optimize the working process in an emergency. AI-based dispatch, triage, and clinical decision support systems will also hasten delivery of critical care and reduce the distribution of resources. AI-based predictive modelling experience has also been demonstrated to reduce ambulance response times by 12 per cent, AI-based triage systems shorter emergency dispatch delay by 30 seconds per call and AI decision support systems have lowered on-scene delays by 15 per cent in situations of life threat. An example of how AI can enhance quicker responses and improved patient outcomes is the Emergency Call Assistant (ECA) system, [10]which is 92.7% accurate in its capacity to predict the type of emergency, as well as operate in real-time, making it perfect.

B. Significance of the MedAssist Solution

The MedAssist solution is a powerful solution to the ongoing difficulties in the sphere of healthcare. It also transforms prescription into a readable, digital format, which significantly enhances access to all: pharmacists and the patients, eliminating errors in medication and enhancing compliance. Specific retrieval of medication names, dosages, and frequencies, along with the convenient interface, [18]makes the task of medical workers and patients easier in addition to improving patient safety and awareness of their medications. This guarantees evidence-based patient-centred and best clinical practice prescriptions. It is also crucial because the accuracy and efficiency of the system in processing prescription data are critical to improving the quality of patient care, lowering the operational costs, and also promoting active participation of the patient in managing their health conditions.[10]

C. Generalizations of Work Implications

The successful adoption of AI as we have found in our study implies the paradigm shift to a proactive, personalised and patient-centric model of healthcare. AI technologies allow recognizing the health worsening early, making the diagnosis more precise and developing the individual treatment plans, shifting to the preventative approach healthcare. This enhances the outcomes and quality of life of the patients as well as by minimising the burden on healthcare systems and associated costs, through reducing readmissions to the hospitals and the resource allocation practised. The focus on the user experience enhances increased adoption and makes complex medical information easier to access, which leads to more patient awareness and compliance.[16]

D. Future Research Areas

The capabilities and reach of such AI based healthcare solutions may be further increased, future research may consider:

- **Integration of IoT Wearables and Sensors:** The use of IoT wearable devices and biosensors would allow providing continuous, real-time remote patient monitoring of a large proportion of conditions, including chronic diseases and emergencies. It involves the monitoring of the vital signs (e.g., heart rate, blood pressure, oxygen saturation, temperature) alongside physical activities and particular biomarkers to identify an early

worsening and offer personalised interventions. Problems over data quality, processing power, security and unreliable network connectivity to remote locations have to be resolved in order to be widely adopted.[7]

• **Enhancement with Telemedicine Features:** It should be developed with built-in telemedicine functions, which would provide remote consultations, virtual health assistants, diagnostic work remotely and more advanced medication management on the platform. This would further increase accessibility, in particular to the vulnerable population or the underserved region, and continuity of care in times of crisis. These developments would need strong attention towards the privacy of data, ethical standards, and a smooth integration into the current clinical operations.

• **Advanced Data Analytics and AI Model Refinement:** The future may be working on hybrid AI models that can integrate predictive analytics with spreading of decisions to streamline operations more. This involves widening its compatibility with more forms of prescription and refining post-processing and classification methods to even greater accuracy and precision on all forms of prescriptions that are being made. Furthermore, the investigation of video-based options in the field of improved monitoring and response may provide new opportunities in care delivery.[3]

By targeting such aspects, MedAssist and other AI solutions will be able to develop further to provide more complex and accessible healthcare services to the global population.

REFERENCES

- [1] T. Jabeen, H. Ashraf, and A. Ullah, "A survey on healthcare data security in wireless body area no. 10, pp. 9841–9854, Oct. 2021, doi: 10.1007/s12652-020-02728-y.
- [2] A. Almalawi, A. I. Khan, F. Alsolami, Y. B. Abushark, and A. S. Alfakeeh, "Managing Security of Healthcare Data for a Modern Healthcare System," *Sensors*, vol. 23, no. 7, Apr. 2023, doi: 10.3390/s23073612.
- [3] M. Zarour *et al.*, "Ensuring data integrity of healthcare information in the era of digital health," *Healthc Technol Lett*, vol. 8, no. 3, pp. 66–77, Jun. 2021, doi: 10.1049/htl2.12008.
- [4] Gusain, N. (2025). Cardiovascular Disease Prediction through Machine Learning: A Comparative Study of Ensemble Techniques. *Revolutionary Advances in Computing and Electronics: An International Journal*, 27-40.
- [5] "Information Security Management Systems (ISMS) on patient information protection within the healthcare industry in Oyo, Nigeria."
- [6] D. Patel, "Comparing Traditional OCR with Generative AI-Assisted OCR: Advancements and Applications," *International Journal of Science and Research (IJSR)*, pp. 347–351, Jun. 2025, doi: 10.21275/sr25603211507.
- [7] G. Datta, S. Sreya, P. Rajarajeswari, and S. H. Raju, "TRANSFORMING IMAGES TO INSIGHTS: OCR- DRIVEN SENTIMENT ANALYSIS FOR MEDICAL DATA CLASSIFICATION," *J Theor Appl Inf Technol*, vol. 31, no. 2, 2025, [Online]. Available: www.jatit.org
- [8] M. K. Sanjeevaiah, M. A. Lateef, M. A. Mufasil, M. Ganesh, and P. Kumar, "Medical Prescription Optical Character Recognition," *International Journal of Engineering Technology and Management Sciences Website: ijetms.in Issue*, vol. 3, 2024, doi: 10.46647/ijetms.2024.v08i03.031.
- [9] G. Datta, S. Sreya, P. Rajarajeswari, and S. H. Raju, "TRANSFORMING IMAGES TO INSIGHTS: OCR- DRIVEN SENTIMENT ANALYSIS FOR MEDICAL

- DATA CLASSIFICATION,” *J Theor Appl Inf Technol*, vol. 31, no. 2, 2025, [Online]. Available: www.jatit.org
- [10] A. Kushwaha, P. Prasad, A. Singh, T. Sharma, and V. Deshwal, “AI-Driven OCR for Comprehensive Medical Label Interpretation,” in *2025 3rd International Conference on Communication, Security, and Artificial Intelligence, ICCSAI 2025*, Institute of Electrical and Electronics Engineers Inc., 2025, pp. 171–176. doi: 10.1109/ICCSAI64074.2025.11064524.
- [11] D. Roja Ramani, B. V. Santhosh Krishna, L. Balaji, S. Sathyanarayanan, M. Muthumanickam, and S. Kaliappan, “PrescriptIQ: Revolutionizing Healthcare with AI-Powered Multilingual Prescription Decoding,” in *Proceedings - 2024 5th International Conference on Image Processing and Capsule Networks, ICIPCN 2024*, Institute of Electrical and Electronics Engineers Inc., 2024, pp. 395–400. doi: 10.1109/ICIPCN63822.2024.00070.
- [12] Thiyagarajan, K., & Natarajan, H. (2025). Pharm-AI: An Intelligent Chatbot for Addressing Medication Accessibility and Information Challenges During the COVID-19 Pandemic.
- [13] M. Agrawal, V. Mishra, H. S. Jogani, P. Kashyap, and R. G. Mishra, “A Review of Artificial Intelligence in Medical Prescription Analysis,” in *Proceedings - 2023 3rd International Conference on Pervasive Computing and Social Networking, ICPCSN 2023*, Institute of Electrical and Electronics Engineers Inc., 2023, pp. 35–43. doi: 10.1109/ICPCSN58827.2023.00014.
- [14] S. Jasmine, C. Rupa, and R. Srikavya, “Medicine Drug Name Detection Object Recognition using Deep Learning based OCR System,” in *International Conference on Integrated Intelligence and Communication Systems, ICIICS 2023*, Institute of Electrical and Electronics Engineers Inc., 2023. doi: 10.1109/ICIICS59993.2023.10421226.
- [15] A. S. Musthafa, S. Bhuvaneshwari, S. S. Dharshini, U. Gobika, and R. Harini, “Enhancing Patient Safety with Machine Learning: Automating the Interpretation of Handwritten Medical Prescriptions,” in *Proceedings of the 4th International Conference on Ubiquitous Computing and Intelligent Information Systems, ICUIS 2024*, Institute of Electrical and Electronics Engineers Inc., 2024, pp. 864– 869.
- [16] A. Tahernejad, A. Sahebi, A. S. S. Abadi, and M. Safari, “Application of artificial intelligence in triage in emergencies and disasters: a systematic review,” Dec. 01, 2024, *BioMed Central Ltd*. doi: 10.1186/s12889-024- 20447-3.
- [17] Sandeep Kulkarni, Shradha A. Sudevan, Tanmay Chaure, and Sakshi Gulve, “AI-Driven Optimization of Emergency Medical Services,” *World Journal of Advanced Engineering Technology and Sciences*, vol. 15, no. 2, pp. 697–706, May 2025, doi: 10.30574/wjaets.2025.15.2.0572.
- [18] A. Bajwa, “AI-BASED EMERGENCY RESPONSE SYSTEMS: A SYSTEMATIC LITERATURE REVIEW ON SMART INFRASTRUCTURE SAFETY,” *American Journal of Advanced Technology and Engineering Solutions*, vol. 1, no. 01, pp. 174–200, Feb. 2025.
- [19] Sharma, H., Kumar, P., Shrivastava, G., Sharma, K., & Bhola, A. (2026). Using Machine Learning for Protecting the Security and Privacy of Internet of Medical Things (IoMT) Systems. In *Integrating Cloud, Fog, and Edge Computing in Healthcare: Federated Learning and Blockchain Approaches: Harnessing Distributed Technologies for Enhanced Healthcare Delivery* (pp. 123-138). Cham: Springer Nature Switzerland.
- [20] M. Sudhi, T. R. Aishwarya, D. K. Shetty, J. M. Balakrishnan, S. Ahmad, and P. P. Sankaran, “AI- driven innovations in emergency and disaster response:

- strategies for effective planning,” *Proceedings on Engineering Sciences*, vol. 7, no. 2, pp. 1293–1304, 2025, doi: 10.24874/PES07.02C.009.
- [21] Z. Araouchi and M. Adda, “A Comprehensive Literature Review on AI-Assisted Multimodal Triage Systems for Health Centers,” in *Procedia Computer Science*, Elsevier B.V., 2025, pp. 206–214. doi: 10.1016/j.procs.2025.03.029.
- [22] Khan, S., Khari, M., & Azrou, M. (2025). IoT in retail and e-commerce. *Electronic Commerce Research*, 25(4), 3009-3010.