Model based using Artificial Intelligence to Overcome the Human Resource Problem in the Healthcare Industry

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ABSTRACT

Artificial intelligence can be used to efficiently automate diagnostics, analytics, logging, administering, and decision making in the healthcare industry which is facing a human resource crunch in the present times. Artificial intelligence though offers very attractive solution for automation and cyber physical systems; but comes with technical, legal and most importantly ethical concerns. In this work, we discuss the challenges associated with incorporation of artificial intelligence in human resources management. We suggest a layered framework to adopt AI based tools and techniques for improving healthcare services. We also discuss the roadmap to evolve into a smart healthcare industry with clear separation of tasks between cyber physical systems and the human resource. We conclude this work by discussing the possible future directions in the area.

1. INTRODUCTION

In any organization, human resources and their management is considered to be the most crucial managerial activity [1] HRM involves adoption of many heterogeneous and varied techniques for staffing, recruitment, training, skilling, employee performance management, compensation etc. Key aim of HRM is to keep employees motivated and enable them (present and prospective) to contribute directly or indirectly to support the organization's objectives and vision. Over the last few decades, techniques and practices from many other domains such as psychometric tests [2], optimization for the operations search [3], transitioning to e-HRM [4], talent prediction using decision trees [5] etc. have been incorporated to achieve the human resource workflow and efficiency.

Artificial Intelligence has emerged as yet another promising vertical with potential to strengthen HRM practices in organizations at all levels. AI driven technologies can help the organization to improve transparency and objectivity in HRM, to assess employees' dissatisfaction or lack of interest in their tasks, to identify factors affecting growth and development of the organization, and to identify training needs etc. This technology provides solution to make analytical predictions, solving the performance related issues, and to economize on time by providing quick solutions. Modern HR values employee satisfaction. Organizations nowadays are sincerely concerned about employee motivation and to know about their KPAs. AI generated platforms can provide numerous opportunities to know employees better.

Globally, organizations are transforming their way to deal with employees through continuous interaction. There are chat bots working as assistants, to help HR personnel from training to learning. Organizations are leveraging the benefits of AI by adopting it as an asset and connecting technology with human beings to enhance their performances. Whether it is writing a job description or preparing the concluding remarks of a team; AI finds relevance practically everywhere. AI enabled dashboards provide easily accessible real time data for better decision making. AI even provides conversational assistance.

Keeping in view the ever-increasing importance and relevance of AI, this paper discusses the existing HR related challenges of healthcare industry and the potential of using AI to manage these. An AI based model and a related step by step process of migrating towards a smart healthcare industry has been proposed. The paper also discusses the challenges associated challenges with the integration of AI and HRM.

Rest of the paper is structured as:

Section II - Discusses the potential of artificial intelligence and its implications for human resource management in the future.

Section III - Points out specific issues dealt by human resource management in the healthcare industry.

Section IV - Specifies the challenges faced by the integration of artificial intelligence in the domain of healthcare.

Section V - Presents our model for designing smart artificially inspired healthcare facility which can solve the human resource problem.

Section VI – discusses the future directions for the health industry with respect to artificial intelligence.

It also highlights our future directions with respect to this work. Finally, we conclude our work.

2. SCOPE OF ARTIFICIAL INTELLIGENCE

Integration of artificial intelligence and the cyber physical systems in the last decade has led to emergence of numerous potential applications, one of which is smart healthcare. Using artificial intelligence to solve medical problems based on input, medical tests, diagnostics, results, analysis and prediction paves the way for future of healthcare.

HR related tasks can be artificially engineered by using automation and algorithmic prediction. Automation of tasks include partial to complete transference of workload to machines, shifting the focus away from labor intensive tasks. Automation reduces the cost of operation and increases the performance. Due to the benefits involved, constant efforts have been put into the transition from humans to machines.

Data is the new oil. Using mining algorithms on data to find out hidden patterns, information etc. holds a vast potential to find knowledge which is unexplored by us as of now. Machine learning, neural network, decision support systems, deep learning etc. are all subsets of artificial intelligence which specifically work on data to produce valuable information. Artificial intelligence can be used to design self learning systems which can improve their functioning with time as more and more data is entered into it. It keeps on evolving and thus offers great opportunities to be leveraged by the current industries.

Using statistical techniques based in machine learning to find out the probability of disease occurrence in a set of patients. By training models on health dataset, it can be found what particular treatments will work. By using deep learning and neural networks, the potential and impact of cancerous lesions in the body can be quantified. [6]

Healthcare systems across the world are constantly generating heterogeneous data which needs attentions for assessment and analysis. Using AI for real time support in healthcare requires ubiquitous server, decision support, surveillance, predictive and descriptive medicine, personalized prescriptions and much more. Developing analytical models by pre-processing data, choosing suitable algorithms and cross validating results will give ideal results for medicine and treatment observations.

It has become an ardent need for organizations to adopt AI for business solutions. Natural Language Processing is used by organizations to automate redundant tasks thereby leaving scope for those people to adhere to other more competent tasks. [7] It is not merely the use of technology but it provides the SMART techniques to deal with HR also. Industry 4.0 revolution presents the ideas of Automation. [8] No more recruitment hassles will be overheard when the things will be amplified by the use of AI in HR. [9] To assist in executing HR tasks; AI is the most efficient domain which needs integration in multiple domains. Whether it is training, testing of candidates for recruitment, advertisement, automating reports and services, performance management or it is about integrating cyber physical systems into industry; AI will pave its way into every process, domain and industry.

3. ISSUES WITH HUMAN RESOURCE IN HEALTHCARE

Following are major HRM related issues of healthcare industry:

a.) Staffing or HR Planning: Provisioning employees for the healthcare industry both in terms of quality and quantity is a severe issue. [10] This issue concerns current recruitment as well as the needs of future personnel in the industry. It envisages numerous sub-tasks such as requirement planning, selecting, recruiting, day to day task assignment, job role management, relocation, dismissal etc.

b.) Lack of skilled personnel: Healthcare demands skilled workers with an ample education as well as training before they can be deployed in facilities. [10] This sector across the world faces a crunch of

community health workers, nurses, doctors, surgeons etc.

c.) Selection and Recruitment: Owing to the critical nature of the work involved in healthcare industry, proper screening of interested candidates, reaching out to potential staff, selecting as per required skills and qualifications etc. are certain important challenges faced by the industry.

d.) Training and Deployment: After recruitment comes the phase of training. Training the recruited personnel with respect to their job role and their deployment in appropriate divisions and departments is another important issue.

e.) Continuous Skill up-gradation: With the constantly evolving knowledge and expertise in healthcare industry, there is a need of continuous training. Expansion in specialized areas is a mandatory and important requirement of the industry.

f.) Performance Management: Performance management involves appraisal, qualification management, periodical achievement assessment, stress/work management etc. and is an important function with individual performance improvement in view.

g.) Referrals, Compensation, and Employee Relationship Management: Deciding the matrices for employee performance and allotting referrals while keeping the revenue and other factors in consideration. Using the trained data models to assist in managing and addressing the queries of personnel with appropriate support can be done by using AI based algorithms.

4. AI BASED HUMAN RESOURCE MANAGEMENT: CHALLENGES

While incorporating AI based systems, the key issue lies in adoption of automated and intelligent systems by people. The behavioural resistance present within the staff in adopting technology is due to the fear that their livelihood will be snatched away from them. Another critical factor is the experience of emotional disconnect for patients and employees. Key challenges with regard to incorporation of AI in healthcare industry are:

a.) Complexity of human resource outcomes: Using artificially engineered algorithms to predict employee behaviour, employee capability and performance appraisal is a highly complex task. There

is discrimination on the basis of gender, personality traits, bias etc. [11] AI based algorithms work on the basis of historic data which in itself can produce biased predictions leading to generation of unfair outcomes. Hiring and firing of employees may result in outright discrimination based on historic unfair practices. In 2018, Amazon had to shut its own system for predicting best performers as it discriminated against women.

b.) Data provenance and data confidentiality: Health related data is transmitted online and thus introduces origin as well as confidentiality related challenges. Storing user health data in the servers for longer periods of time, for training algorithms, for third party exchanges; all are challenges which needs particular attention.[12] Deciding the origin, lineage and exchange of data before using it for training models needs proper guidelines and legal adherence to work with. [13]

c.) Need for exhaustive, unbiased data: In order to train expert systems, huge datasets are required which help in training the models along with expert knowledge and input.

d.) Interpretation of methodological approaches and safety issues: [14] There is a gap between the use of theoretical knowledge and implementing it in practical areas. There is a strong need of methodology which can be used as a standard for integrating new technology into the industry. Safety related issues are a key concern while designating tasks to machines, especially in healthcare where testing and surgical procedures are life critical in nature.

e.) Hasty generalization and the lasting effects of real-life decisions: Trusting AI based systems for critical work as in healthcare can have long lasting impacts on the concerned individuals. Most of the times, techniques and HR based practices are too generalized leading to hasty outcomes in the longer run.

f.) Discrimination based on bias: If the data is biased in the first place, it leads to generation of a biased system which will discriminate on the basis of gender, colour, regions etc. There can be personal bias, promotion bias, discrimination; all depending on the historic dataset.

g.) Personalized and precision medicine: Identifying diseases on the basis of symptoms and information produced via tests, wearable devices is a difficult task because of heterogeneity of factors involved.

[15] Disease related historic patterns, genomic data, clinical data etc. might lead to disingenuous diagnosis, thereby misleading towards a treatment and further prognosis. [16]

h.) Social, legal and ethical dimensions: Use of AI backed systems to make decisions for healthcare has led to emergence of accountability issues, privacy concerns, transparency and permission issues. [17][18] Use of deep learning along with unsupervised algorithms generates meaningful decisions but machines fail to ethically, socially and emotionally take a decision which is humane in nature.
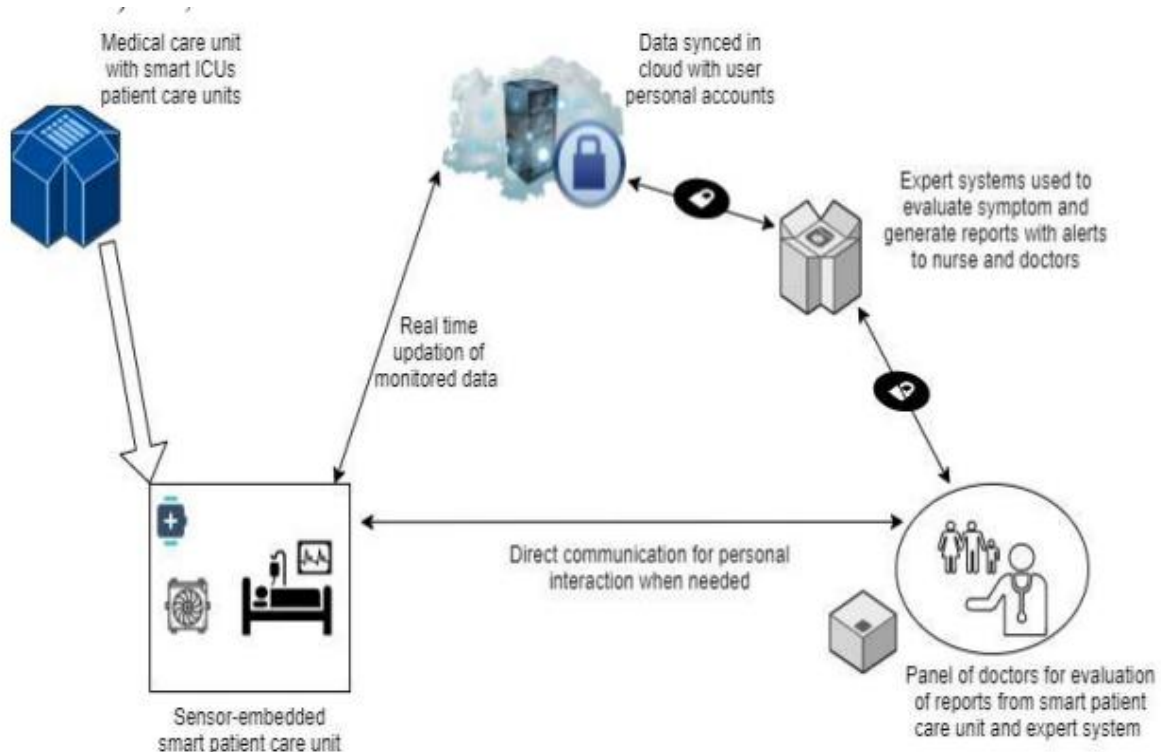
5. PROPOSED MODEL

Integrating artificial intelligence in the healthcare industry needs a phased implementation to minimize the resistance in adoption as well as to minimize the errors in practical implementation. We propose a 5 phased model for implementation with distributed yet independent modules to achieve a resource rich, automated and intelligent healthcare facility.

a.) The first phase includes the digitization of parking, of receipt generation, department allocation, visiting fee deduction. By incorporating kiosk typed machines at various points within the medical facility will not only help in reducing the need of staff but will also help in automating redundant tasks to store information in a structured manner.

b.) The second phase must be achieved via automation of testing facilities. Integration of cyber physical systems, automating machines for minimum human intervention, which sense the environment as input and take action as preprogrammed for generating output in the form of reports.

c.) Third phase includes interlinking the generated report to the patients account so as to maintain real time information transmission about health data. This phase will combine heterogeneous sources of data into one unified portal with pre-processed data and up to date analysis.

d.) The fourth phase focuses primarily on establishing a data analyzing team which can work on mining useful information from the stored data so as to enhance the working of other departments. Analyzing doctors performance, user satisfaction, test report based prediction, long term vs. short term prescriptions, adjustment of staff including transfer and dismissal, automated hiring of staff etc.

e.) The fifth phase works on establishing independent training facility with cutting edge infrastructure to help the employees learn, practice and use newly acquired skills. With respect to an employee's portfolio, appraisal, training, handling and attainment of job objectives, skill enhancement etc.

The migration must happen with the introduction of technical and medical experts who can handle the management of data in the first place. The structure for user account generation, indexing of data, sending to workplace activities area, to parking etc. must be formulated as per the organizations need.

1. User enters

2. Entry module: ID (index) number is assigned, and user connected to his account

3. If emergency, redirect to emergency facility

4. Parking needed?

    a) Yes, redirect to parking facility

    b) No, redirect to Facilitation centre

Figure 1 - <u>Working of smart patient care unit with expert systems and cloud storage.</u>
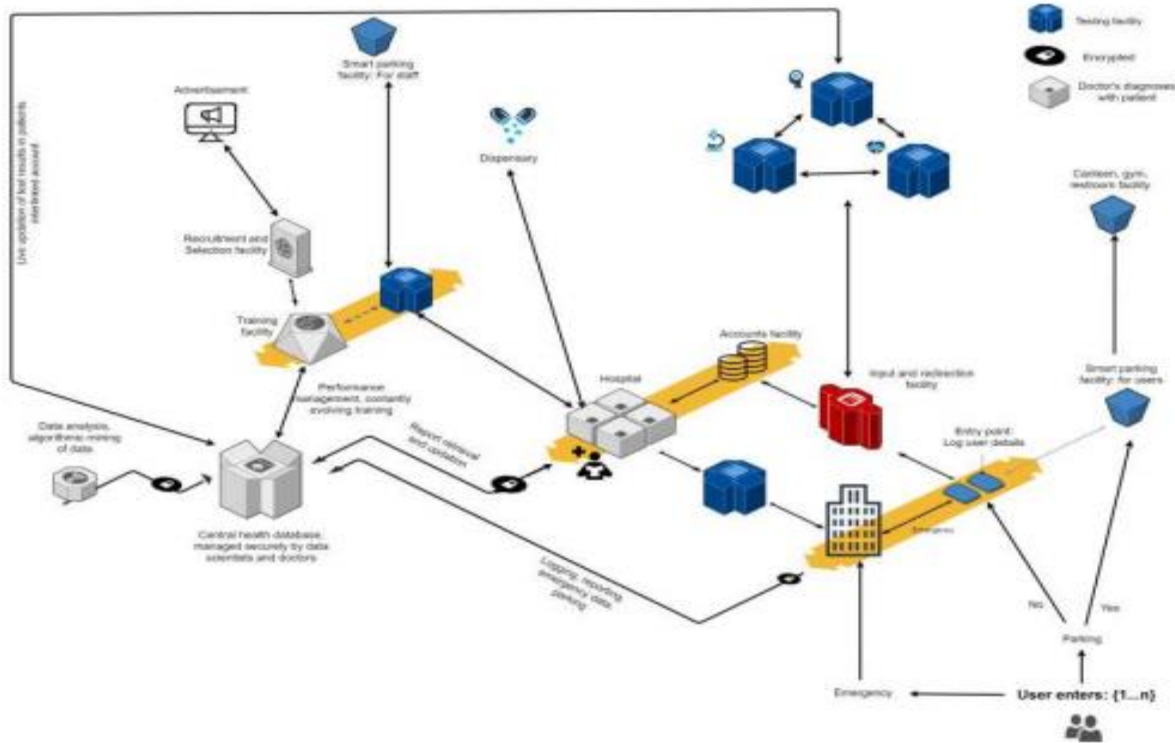
Figure 2 - <u>Proposed model for solving human resource problem in healthcare industry.</u>

1. Input and redirection facility: Input the symptoms, user details, generate the receipt and redirect to appropriate testing facility. Decision is made using the historic database of the organization based on symptom driven practice, user's previous health records are also consulted before making an informed choice by the system.

2. Testing facility: Automated systems which assist the user in getting the tests done. The reports are directly updated in the user account. Once the tests are done, user goes back to Input and redirection facility.

3. Depending upon the schedule of doctors, results of tests, condition of the user; the system decides the time and date of appointment by using decision support systems.

4. User is sent to accounts section for the payment of services. Accounts section is designed in the ATM like machines so as to reduce the manpower used. The core system handles the transactions and updates the user accounts for the payment made.

5. The user goes for appointment in the facility where doctors will assess the findings. History of user's health reports, current reports, smart predictions are present with the doctor prior to the appointment thereby making the process even more efficient.

6. After consulting the doctor, user enters the dispensary to get the medicines and pays again via online mode.

7. The user then exits the system and the account is made offline. User account within the health facility stays online as long as the person is within the facility.

The medical care unit is composed of small sensor-rich smart patient care units which monitor patient's health in real-time. This helps in reducing redundant effort by nurses and doctors for visits and monitoring. The synced data is maintained at the cloud storage which works in close collaboration with expert systems. The expert systems are trained on labeled healthcare dataset to devise weight matrix which is used to decide when the patient needs personal assistance. Expert systems are trained to give better results by incorporating doctor's expertise, vast user health data inputs, symptoms and interconnections found by research and by the system itself. Supervised and unsupervised learning techniques give the autonomy to the system for generating better results.

6. OPEN ISSUES AND FUTURE DIRECTIONS

AI powered systems are used for logging patient response, discussions, payment history, identifying success of prescribed treatments, automating & assisting in surgical procedures etc. AI can be used to optimize the process of insurance coverage claims, fraud detection, claim adjudication. Predictive ability of AI based systems can be used to tailor the solutions as per personal needs, health history and predicted state of the user. AI inspired HRM needs to further address some major research issues such as:

a.) Formulation of a data flow, storage and accessibility strategy which will strictly define what data is being

acquired, which pathway does it follow before it is stored, who can access it, where and how it is stored etc. Adhering to the legal bounds for maintaining personal data and extracting full benefit of AI is a challenge.

b.) Decreasing the resistance between adoption of smart infrastructure and practices by the human workforce. Dealing with behavioural foreignness with regards to AI can be a conflict for future and a possible issue to work upon.

c.) Development of AI backed systems will go on but the real challenge will still remain in the adoption of technology in daily clinical practice by people. There is a wide gap between empathetic connection between doctor-patient and the non-emphatic communication by machines. A lot of resistance is faced by individuals in adoption because of the kind address which is need while discussing life threatening diseases and treatments. [19]

d.) Safety and accountability of expert systems need careful attention if we want to integrate and automate multiple work fronts of healthcare industry. There is a lack and confusion with regards to accountability of decisions being taken. Safety in critical matters also needs careful work to design fail-proof, error prone and fault tolerant systems.

Hype of AI on the cusp of emerging as the next big thing in technology could not match the reality as yet. However, the Covid-19 pandemic has paved the way for the AI's moment to finally mark its presence. The technology has found extensive use in healthcare industry to manage this pandemic like to identify, track and forecast outbreaks and infectious disease risks; help diagnose the virus; process healthcare claims; use of drone and unmanned aerial vehicles for safe and fast delivery of medical supplies and medical samples; drug development; to ensure compliance by infected individuals; to fast-track the development of a vaccine etc. Many companies have, in fact, put AI based technologies to such uses.

In future work, we would aim to produce a detailed phased implementation which can be practically integrated into the existing health infrastructure. We also aim to work on performance enhancement modules inspired by artificially intelligent algorithms which can adapt as per the learning outcomes of the employees.

7. CONCLUSIONS

In this work, we proposed the integration of AI to address the human resource management issues faced by the

healthcare industry across the world. We proposed a model with a phased implementation to solve this problem by integrating automation and intelligence across the infrastructure. We also discussed the challenges and issues faced by the healthcare industry with regards to human resources management. We conclude by outlining the future directions for the same.

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