Designing an AI Healthcare System: EHR and Priority-Based Medical Segmentation Approach

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ABSTRACT

Since the formulation of digital systems and the rapid advancements in the domain of modern technology in terms of computing and device peripherals that resides within the realm of which is revolving around perspective concepts, with its associated aspect of implementations such as Artificial Intelligence (AI), Machine Learning, Deep Learning, Cloud Computing, Smart Digital Systems are now booming out with an acceleration of apex proportion in the various diversity of fields within the domain of engineering. Especially in the field of Bio-Medical Engineering these aspects can play significant roles considering for the human conditions and anatomy perspective. Health which is the top priority of perspective, giving scope to human conditions and with the continuation of time and increase of diseases along with, fatal issues revolved around the human health, it is of upmost and great importance to find the optimum solutions for all the cases of scenarios. This research focuses on that aspect of perspective towards the Electronic Health Record (EHR) system with its usage in accordance with an Artificial Intelligence (AI) for providing an optimal solution presented to it where the issues are tackled with prioritization and segment queue and an overall proficiency for the optimum results in direct relation to performance efficiency with the prototype version that is developed, deployed and experimented with for the conduction of this research.

Keywords: Artificial Intelligence (AI), Biomedical Engineering (BME), Data Mining, Deep Learning, Machine Learning.

1. INTRODUCTION

For over a decade in the recent years, technology has been booming in the medical field with the patient information systems and after the renovation, developed by USA for health record monitoring dependencies in the recent times and currently termed as Electronic Health Records (EHR) it has minimized much of the data information issues. Considering the patient activities on a daily day to day basis this conceptuality and its layout architecture as a software has brought some radical changes in concerning for patients as well as doctors.

However, the rush of information has not lessened to a great detail and not properly optimized due to the rapid increase of diseases in humans and the need for medication and doctor appointments at a daily level and further checkups. Most countries globally around in the world have this mechanism and uses this particular implementation for medical systems but not all are at the top of the list as there are still many areas where the implementation has a wide range for limitations due to the issues revolving around and concerning both the doctors along with the respective patients associated with the process. And in a country like Bangladesh which is still under development and lags behind in various areas from the rest of the world and especially growth within the medical sector still lags behind in many aspects to a great extent. At the same time, the continuity of disease has not lessened at all. Moreover, it has increased at a very high and significant amount within the last few years and especially after the COVID-19 pandemic it skyrocketed to a completely whole new level. So, to put it simply, an optimum EHR is required and is also very essential for the human conditions concerning the prospect of Bangladesh. Also, the prototype implementation should also be prioritized in a manner where it will encapsulate to provide the optimum solution to the problems and issues provided to it. This is where the research mainly focuses on and it also provides the insight into the design and development of the prototype created to meet the criteria mentioned and applicable for usage and activity.

2. METHODOLOGY

The methodology and methods used to concern the research resides within a pipeline of step-by-step systematic approach towards the investigation which convolutes around the impact of AI and EHR systems within the landscape of Biomedical Engineering. Firstly, it begins with a detailed comprehensive background iterative research towards the gathering for the available existing knowledge and at the same time, potential context with identifiable research gaps. Secondly, the necessary data formations and its segmented collection are mapped in the KNIME data analytics platform then data mining was performed using various appropriate methods and functionality toolsets, and all the collected data also had undergone preprocessing and post processing in order to ensure that its quality remained with relevance towards the perspective domains. Next, all the performance and visualization of these feature techniques are programmed and design illustration prototyping were evaluated using suitable metrics and afterwards compared with various traditional and existing technical computing approaches. Afterwards, all the results were analyzed and interpreted within the context of the research objectives, discussing the implications for EHR and all the advancements within Biomedical Engineering which would result in many future speculations. Lastly, the findings were summarized, limitations were acknowledged, and suggestions for any type of future research prospects were also mentioned. This methodology enabled a very comprehensive exploration of how the designed prototype can enhance Biomedical Engineering perspective and how AI will fall within the digital world systems, paving the way for better and improved terminologies with better outcomes and advancements in the field.

3. BACKGROUND RESEARCH AND AVAILABLE KNOWLEDGE

An electronic health record (EHR) is the systematic assortment of patient and population which is electronically-stored as health info formulated inside a digital format [1]. These records may be shared across completely different health care settings based on country rules and government regulations. Records which are shared through network-connected, enterprise-wide info systems or an alternative info of networks and exchanges. EHRs might embody a variety of knowledge, as well as demographics, medical record, medication and allergies, immunization standing, laboratory, taking a look at results, radiology pictures, very important signs, personal statistics like age and weight, and charge info [2].

A decade past, electronic health records (EHRs) were touted because of the key to increasing and demand for quality care. Today, suppliers square measure victimization knowledge from patient records to boost quality that produces outcomes through their care management programs. Combining all these multiple styles of clinical knowledge from the system's health records has helped clinicians establish and stratify inveterately sick patients. According to numeric data from various sources, the EHR systems will continue to improve the quality care by victimization of the information and analytics to stop hospitalizations among unsound patients. EHR systems were primarily designed to store knowledge accurately and to capture the condition state of a patient across different levels of checkup time and undergoing Doctor care. It eliminates the necessity to trace down a patient's previous papers for medical records and assists in making certain knowledge which is correct and readable. It will also cut back the danger of knowledge replication as there's only 1 modifiable file, which implies the file is additional seemingly up to this point and reduces the danger of any lost work. Because of the digital info being searchable and being an Intermediate file, EMRs (an electronic medical record) is more practical and once more the extracting medical knowledge for the examination of attainable trends and future changes during the conduction for any type of patient study. Population-based studies of medical records may additionally be expedited by the widespread adoption of the systems which are EHRs and EMRs. The terms EHR, electronic patient record (EPR) and EMR have usually been used interchangeably, though variations between the model's area unit that is currently being outlined.

The electronic health record (EHR) may also be an additional longitudinal assortment of the electronic health info of individual patients or populations. On the other hand, the EMR, in distinction, is that the patient record created by suppliers for specific encounters in hospitals and ambulant environments, which might function as an information supply for an EHR [3][4]. In

distinction, a private health record (PHR) is an electronic application for recording personal medical information that the individual patient controls and should be build obtainable to health suppliers [5]. The majority of the countries in Europe have created a technique for the event and implementation of the Electronic Health Record (EHR) systems. This is able to signify towards the meaning that, bigger access to health records by various stakeholders, even from countries with lower levels of privacy protection. The forthcoming implementation of the Cross-Border Health Directive and also the EU Commission's plans to centralize all health records that are of prime concern to the EU public [6].

World Health Organization (WHO) believe that the health care organizations and governments can't be trustworthy to manage their information electronically and may even expose them to additional threats. The idea of a centralized electronic health record system was poorly received by the general public. World Health Organization (WHO) as cautious that, the governments might extend the employment of the system on the far side its purpose. There's conjointly the chance for privacy breaches that would permit sensitive health care data to be perhaps represented to the incorrect hands. Some countries have enacted laws requiring safeguards to be placed in situations to guard the protection and maintain privacy and confidentiality of medical data because it is shared electronically and to convey patients some necessary rights to watch their medical records and receive notification for loss and unauthorized acquisition of health data. US and many First World countries also in accordance with the EU have obligatory medical information breach notifications [7]. In prospect to Asian countries this implementation should be acted upon immediately for the betterment of patients and medical systems. Concerning the aspect of privacy and security which should and must be given the apex of priority as the significant data is of immense importance and deals in with a person’s perspective to being alive or dead and should be approached as such. Ethics and morality with rules and regulations of implementation must be invoked to motion, along with that, the retrospect for ensuring patient safety and proper guidelines from medical personal and staffs. The tending info and Management Systems Society, a giant U.S. tending IT business trade cluster, determined in 2009 that EHR adoption rates "have been slower than expected within the US itself, particularly compared to any alternative business sectors and alternative developed countries. A key reason for that, other than initial prices and lost productivity throughout EMR implementation, is lack of potency and usefulness of EMRs presently on the market [8][9]. The U.S. National Institute of Standards and Technology of the Department of Commerce studied usability in 2011 and lists a variety of specific problems that are reported by health care staff [10]. The U.S. military's EHR, AHLTA, was reported to possess vital usability problems [11]. What is more concerning is the fact that, studies like the one conducted in BMC Medical information science and deciding, conjointly showed that, though the implementation of electronic medical records systems has been an excellent help to general practitioners but there's still abundant space for revision within the overall framework and also the overall quantity of coaching provided [12]. It had been determined that the efforts to enhance EHR usability ought to be placed within the context of physician-patient communication [13].

However, physicians’ area unit grasped the mobile technologies like smartphones and tablets at a much faster pace. As per a 2012-2019 survey by Physicians observe, 62.6% of respondents (1,369 physicians, observe managers, and alternative tending providers) say they use mobile devices within the performance of their job. Mobile devices area unit is more used and much more ready to set up with electronic health record systems, therefore, permitting physicians to access patient records from remote locations. With technology improvement in the recent years, that has greatly accelerated this prospect and continuity at a very fast leap moving forward. Most devices like say inside area unit extensions of desktop EHR systems, employing a sort of package to speak and access files remotely.

The benefits of instant access to patient records at anytime and anywhere within area unit clear, however, they still ought to bring several security considerations. As mobile systems have become an everyday additional to human daily life, practices can and most probably would likely to be conjoint into the comprehensive policies that govern all of the security measures and patient privacy laws [14]. On the other part of the retrospect of the matter, the fact cannot be denied that,

advanced machine techniques have allowed EHRs to be evaluated at a far greater faster rate. The tongue process is more and more changing and won't search EMRs, particularly through looking out and analyzing notes and the associated texts that may well be inaccessible for study once seeking to enhance patient care [15]. One study found that, many machine learning strategies might be able to predict the speed of a patient's mortality with moderate success, with the foremost booming approach as well as employing a variety for a wide combination of a convolutional neural network and a heterogeneous graph model [16,17,18].

When a hospital has documented their progress and chosen their code resolution, they have to and should ensure in that, each formulation must then take into account the hardware and supporting device infrastructure for the tip users. Workers and patients must be pipelined in order to, also should have been instructed to be compelled to interact with varied devices throughout a patient's keep and charting progress. Computers, laptops, all-in-one computers PCs, tablets, mouses, keyboards, and monitors area unit all hardware devices that will be used or any other device peripherals that might be involved. Different issues can embrace supporting work surfaces and instrumentality, wall desks, or articulating arms for finish users to figure on or keep track of progress. Another vital issue is however of these devices that are going to be physically secured and the way they'll be charged to that of the workers who will continually utilize the devices for EHR charting once required and if any alteration or modification will be required based on the data provided. The success of eHealth interventions is essentially keen about the power of the adoptive parent assembly to completely perceive progress and anticipate all the types of potential clinical processes before its implementation. Failure to try and do this will produce pricey and long interruptions to service delivery [19,20].

And in the context of Bangladesh this has a long and very high ladder to climb before EHR can go global across the nation as a whole. But hopefully with the timeline moving forward into the near future will come to pass sooner than expected but only time will tell how it will ultimately unfold. Bangladesh today is developing and adopting to the digital era of technology and advancements but the gap between the Doctor and Patient communication is still a vital issue which must be overcome.

The failure to understand and decay from the matter is an affirmative truth that, many people are still ignoring the idea of EHR. But it is also understandable that, many people are unaware of this amazing digital medical system and its usage and applicability that can be a revolutionary and create a change in the medical sector if properly installed with required toolset and resources. The rural area people and the people below the poverty line will have high problem with this system but if the government can take proper steps and ensures heathy guidelines and instructions it will be possible. So, time will tell how it will actually turn out to be.

4. PROTOTYPE DESIGN APPROACH AND ITS IMPLEMENTATIONS

Coming to the perspective of the research, the prototype was made under the aspect of following the standards and concurrent computing peripherals. The main focus was the task handling and patient priority with optimum scheduling which is one of the most required features for an absolute and optimum EHR medical software system. The design implementation that was formulated for the prototype was a simple rundown in accordance to programming perspective.

The platform builds and environmental setup was under the emulation of C# programming language coded within the Visual Studio runtime environment, the prototype was designed and developed and the formulation of analytics were performed in priority segments based on the generated various data mining and processing algorithms of priority management which was done from scratch by the sole author. The layout architecture and design schematics were different based on its implementation and aspects.

Firstly, the AI feature was developed for the prototype to be user friendly and based on user comfort with ease of access. Since the users as in Patients and Doctors were the primary concern for the targeted population. Also, the software had to be equipped with some pre-built features so that it could handle real-time data dynamically generated based on user activity and usage. Apart from that, the feature also was designed so that both users and system would be optimally benefited.

However, please bear in mind many speculations for features and functionality were put in effect but that does not mean that they are the final render. If required and projected based on patient or doctor needs the functionality can be updated and altered based on user requirement. So, the prototype scope is always under development and will be altered based on the chain of command and required necessities from the user end.

Secondly, the server system was optimized based on patient priority which was integrated with the AI feature. Although it's all patient's data but not all cases will be extremely severe or very light. It will always vary from each and every individual patient which is the main reason why this feature was introduced and integrated within the prototype. For any kind of patient, their level of diagnosis will be based on the condition level priority. To understand the aspect of this matter, consider a heart patient and a fever diagnosed patient. Both are patients but there is an order of priority. For instance, the fever patient has time frame scale to undergo his symptoms where in case for the heart patient he has limited time as it revolves around on a human's organ portion so the heart patient will be obviously identified as priority 1.

Thirdly, the payment option was adjusted to meet country demands since each country has its own set of currencies. And it's always a hassle when it comes to currency change at any transaction. A scaled and solid solution on this matter was set in motion but with the passage of time it will be modified based on requirements if the system goes global. Lastly, the scheduling was done so that all the operations could run in one parallel synchronization with each prospect and one another for maximum outputted results and proficiency.

5. THE COVID-19 PANDEMIC AN INSIGHT INTO BANGLADESH

In accordance with the provided data, the COVID-19 pandemic in Bangladesh was a part of the worldwide epidemic of coronavirus complaint 2019 (COVID-19) caused by severe acute respiratory pattern coronavirus 2 (SARS- CoV- 2). The contagion was verified to have spread towards Bangladesh in March 2020. The first three known cases were reported on the 8 March 2020 by the country's epidemiology institute, IEDCR. Since also, the epidemic had spread day by day over the whole nation and the number of affected people had been adding significantly. Bangladesh was the alternate most affected country in South Asia, after India. A case illustration and a WHO dashboard is provided within figure 1 and 2 concerning the COVID-19 Pandemic in Bangladesh.

To cover the population, the government declared a "lockdown" throughout the nation from 23 March to 30 May and prepared some necessary ways to spread mindfulness to keep that pattern down from them. Infections remained low until the end of March but saw a steep rise in April. In the week ending on 11 April, new cases in Bangladesh grew by 1,155%, the loftiest within Asia, ahead of Indonesia, with 186%. On 6 May, cases were verified in all sections of the country. Rangamati was the last quarter to report verified cases of COVID-19. On 13 June, the number of cases in Bangladesh exceeded the number of cases in China, the country where the outbreak began.

Bangladesh reached two grim mileposts of 160,000 cases and 2,000 deaths on 5 July and caught France in terms of the number of cases two days latterly. The number of reclamations in the country exceeded the number of active cases on 12 July. Medical experts stressed that not enough tests were being conducted. Review reports and social media continued to report fresh deaths of cases with COVID-19 symptoms. Some of the departed were treated at COVID-19 insulation centers at hospitals in the sections and others were denied treatment, though no tests were conducted to confirm contagion [22-30].

For a long time, testing was centralized to only the Institute of Epidemiology, Disease Control and Research (IEDCR) in the capital of Dhaka, although cases with symptoms were reported around the whole country. On 22 March, Bangladesh declared a 10-day shutdown effective from 26 March to 4 April. This was latterly extended to 30 May. Besides, Medical grade Oxygen had been a concern to look at as the present demand for Oxygen in Bangladesh which was around 200 tons a day for medical treatment purposes, which had a significant possibility to elevate at an exponential rate every day.

As a consequence, to meet up the implicit requirements, Bangladesh had needed to ready itself, by establishing a demand soothsaying model for medical grade Oxygen at the foremost with

the coordinated sweats of Department of Public Health Engineering (DPHE); and Institute of Epidemiology, Disease Control and Research (IEDCR). A series of hotline figures, dispatch address, and the Facebook runner of the Institute of Epidemiology, Disease Control and Research (IEDCR) were handed out towards the people to communicate if they suspect COVID-19 infection or need further information. It was an event unlike any other and still makes a case issue even to this day.

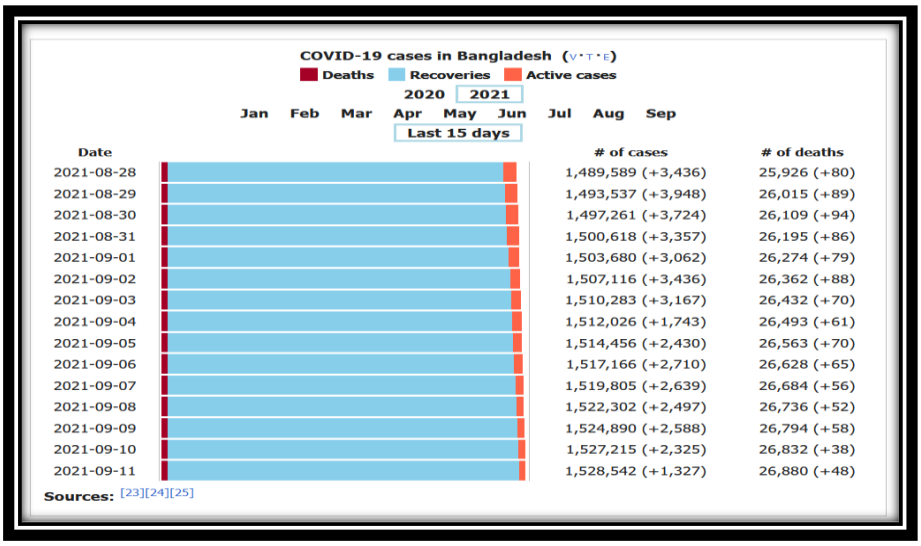

Figure 1. A Case Illustration of the COVID-19 Pandemic in Bangladesh

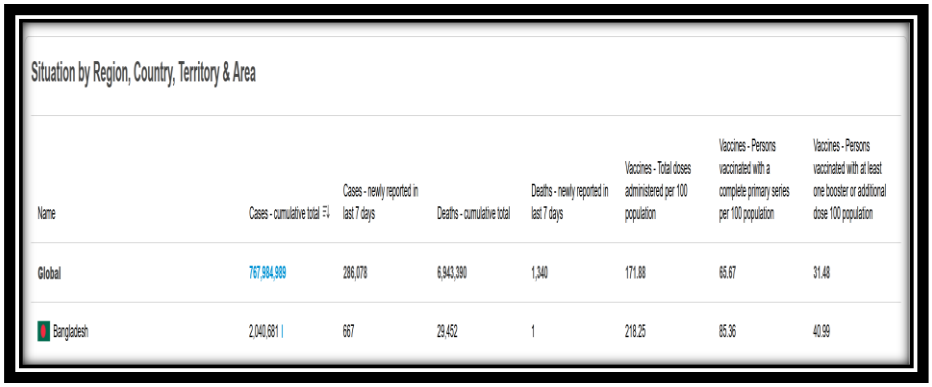

Figure 2. WHO COVID-19 Pandemic Bangladesh Dashboard

The pandemic not only degraded the lives for a great number of people but also caused server deaths which throughout the country was one of the hardest and saddest moments in Bangladesh history. This level of universal threat is something that must be taken into account and prepare for the upcoming future if something like this ever takes place once more and be ready to undergo it with better solutions.

The pandemic showed even in the digital era of technological advancement the medical sector still needs more innovations and discoveries. This provides to the depth of how much uncertainty human life cycle can revolve around in terms of medical treatment. The prospect of this disaster could have been eased to a great extent if the EHR system was deployed within the context of Bangladesh. Many lives and many worsen situations could have been treated better with a great scope of technological solution. This can serve as a reminder for future retrospect why a system like this is of vast importance and requires funding for its development and deployment.

6. SIMULATION AND EXPERIMENTAL RESULTS OF THE PROTOTYPE

As many of us are aware of the fact about data manipulation and data exceeding limitations which can degrade the computing proficiency on a high number of levels. Considering the ratio of patients of almost all the hospitals were in real time in every split-second data is being transmitted and received from perspective nodal ends. The server as a result gets overloaded with data and there is always a hassle in patient entry. For this particular problem the priority mechanism was formulated and brought about in this respective research. If each patient had a priority queue list which the software would pursue during entry and schedule each patient in a specific criterion manner programmed within the simulated environment.

To put it simply, a classification of each patient with specific allocation entry. For example, two patients have been enrolled and have to be registered as soon as possible where one has coronary heart disease problem while the other has fever and head pain. Now for the heart patient he is priority 1 as he can most intensely have a higher risk of stroke or heart failure if immediate medication is not provided and the other patient with fever is priority 5 so, priority one will be enrolled first and then priority 5 will be enrolled.

Another example is for a patient with burn injury having priority 2 and the other having digestive problem in stomach having priority 6 where the same method will be implemented for first priority 2 then 6. The priority segmentation will be provided to the software and seeing patient info it will schedule the prospect and organize the patient entries. This priority segmentation can vary and be altered based on individual hospital or clinic as how they want their system to be designed and developed. The design scheme is always subject to change as new diseases are always on the rise.

So, from time to time the pipeline and priority queue will be altered and modified based on patient conditions and requirement of medication and that will be approved from the Doctors themselves. To better understand the mechanics of this prototype a visual representation diagram is provided in figure 3 with the AI implementations design within figure 4 and a Global experimental design in figure 5 for a futuristic implant.

This formation can be further updated with patient brief bio of disease where each parameter will allocate and analyze the probability of severe injury or disease of the patient. Also, based on the data provided to the system, it can be modeled to as per each hospital requirement given by the doctors. This prospect might be a bit difficult to understand but there is also a great matter of risk factor involved as well since most entry will be segmented from the wide variety of data that will be uploaded to the system.

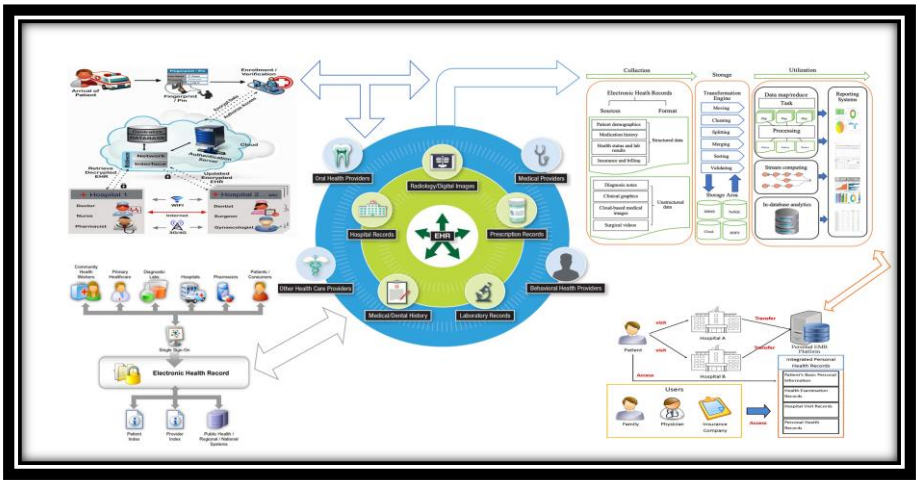

Figure 3. A Visual Representation and Diagram of the Designed Prototype

In the retrospect of this matter, it is also of great importance to note that, the more variety of data and patient entry will be uploaded the better the system can perform as it will have a huge chunk of data to work with. At the same time, performance and efficiency will be of optimum

absolute with how great the data can be trained. The server data entries will follow the same mechanism approach with some genetic algorithmic processing which will perform analytics and process the server data so that it can be scheduled as per patient needs. Apart from that, probability analysis will also work as a second measure during the inspection of data entries. Along with that, data scheduling will also be back propagated from the system memory of previous data stored and record of previous patient entries and manage all of that information from a segmented approach to the users. This will be utilized best once the system has performed for a wide range of years.

However, one thing to note very carefully, during conduction of the research many hospitals were surveyed and contacted for providing their patient data to formulate the design mechanism and dish out the results as per each allocation. Unfortunately, only a very few responded and the ratio was checked for the graphical representation where it distinctly showed most hospitals were unwilling to share their patient data. And some also questioned the benefits and features which are not needed in terms of their understanding and it was unacceptable to many. This is due to the reason that, many individuals do not want the system implemented as it may stop many unfair means of profit. In regard to this matter, it will be best not to highlight too much information as this aspect revolves around governmental level insights. Like many great innovations there are always a backlash and at this instance of the matter let's leave it at that context. It was also evidently clear that, to a wide range of community health concerns were very high and wanted no part in that aspect of the research. But they failed to misunderstand the main concept of the approach as if the data was given then using image processing it would be even possible to identify a patient based on camera feedback using IR and MRI sensors. As the software from the uploaded data with the patient data info and image the computer vision prospect of data calculation can take place and creates the pathway for machine learning along with deep learning to be implemented and provide a probabilistic numerical value of disease identification which will be checked by the Doctor themselves for clarity. This scope of utilization can have an amazing impact in the health sector as many image vision analytics can be solved to a great extent if all the resources were utilized and implemented in a real-time genomics or neuroscience domain. Not only that but also, prospecting with machine learning and deep learning for patient analysis it is also possible to predict future outcomes. A patient with 5 years of data from hospital entries and diseases that took place in his life cycle plus the tests conducted and doctors visited with provided medicines and health records the AI feature will be capable of performing a future scope for that patient based on probability distribution and analytics performed during the data collection.

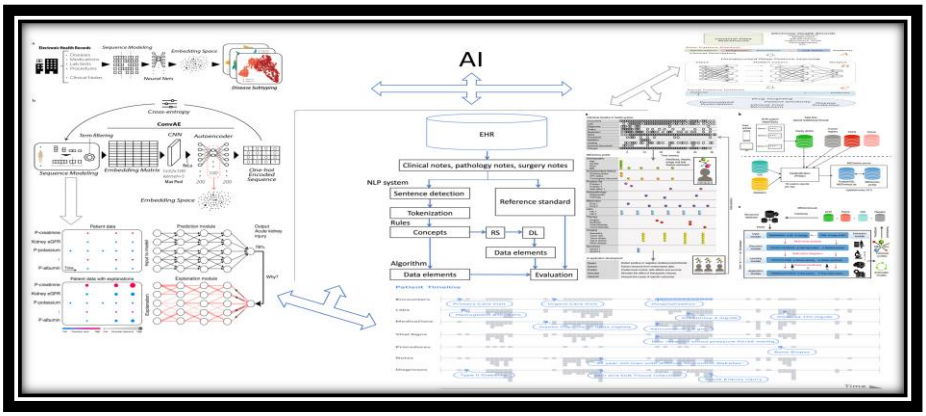

Figure 4. The AI Approach in terms of the EHR Prototype Designs

Not only that, if properly trained with a huge chunk of medical data and records, it will also be possible to even predict and identify future diseases based on previous entries of data. Because the more a digital system has the majority of data classification it can generate a model for probabilistic analysis which will be finalized from a doctor's point of view and guidelines. Many device peripherals integrations can also be possible and bring a revolutionary change and innovation

within the context of medical science and system management. A great example of this can be provided in the research paper [21].

If the data values are given for almost all aspects of disease, then the probability of future disease and scope of arrival and timeline can also be determined. But that will only be possible from huge amounts of data that is stored over the years. One more thing to mention the data entries will also serve as to the previous doctors and hospitals visited where in new entry the new doctor can look into that particular patient history data. This will not only minimize patient info but the new doctor can provide a scenic overview based on the data. Also, the data will be digitally integrated so scope of change and update will also be possible. The patient will have the ability to access this information and the Doctor if required can also refer to someone who might have a better solution on the matter.

Figure 5. A Futuristic Designed Prototype View if it goes Global (Experimental)

For the output generation and graphical analysis and simulation, the KNIME software was used for execution and viewing of the analytics. Different workflow tools and mechanisms were applied for conducting the analysis, breakdowns and results. And the prototype design testing and troubleshooting was conducted within Visual Studio Code runtime environment. The KNIME data analytics platform was used for the conduction of the Medical Data Mining Ecosystem which is illustrated within figure 6 in terms of the prototype experimentation design.

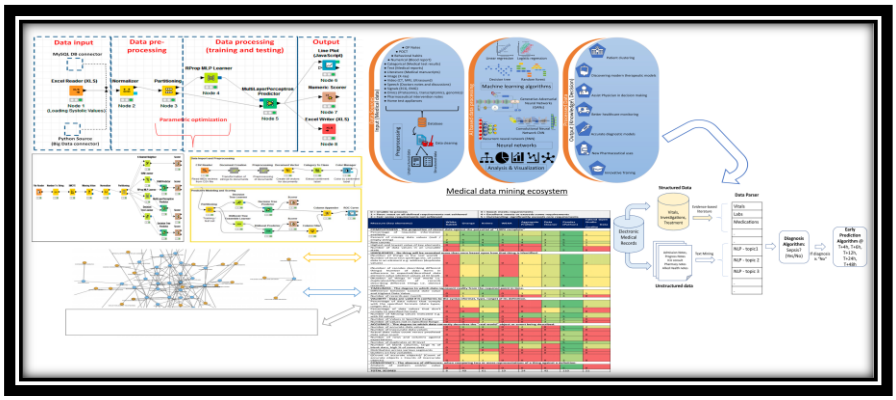

Figure 6. Prototype Design of The Medical Data Mining Ecosystem (KNIME)

For the conduction of the research many hospitals and their associated doctors and patients were contacted and surveyed for the fields of scope concerning the different functional attributes consisting within the prototype design system. As this was an experimental and conductive research many factors and aspects were introduced which pipelines with the various platforms and terminologies in the modern midst of society. Added that, many designs were introduced concerning

the scenario and perspective represented within the segmentation designs for the priority queue concerning both patients and system infrastructure data. For clarity and better understanding on the visualization on the matter and retrospect to the system, the author designed and developed the priority queue database with the research scope set in mind. A schematic visual representation of this system is provided within figure 7 for a better understanding. Please note that, it can be altered if required but for optimum proficiency and the apex performance for the system to work at its peak and results obtained from the survey conducted, the designed priority queue was generated and set in motion for the system.

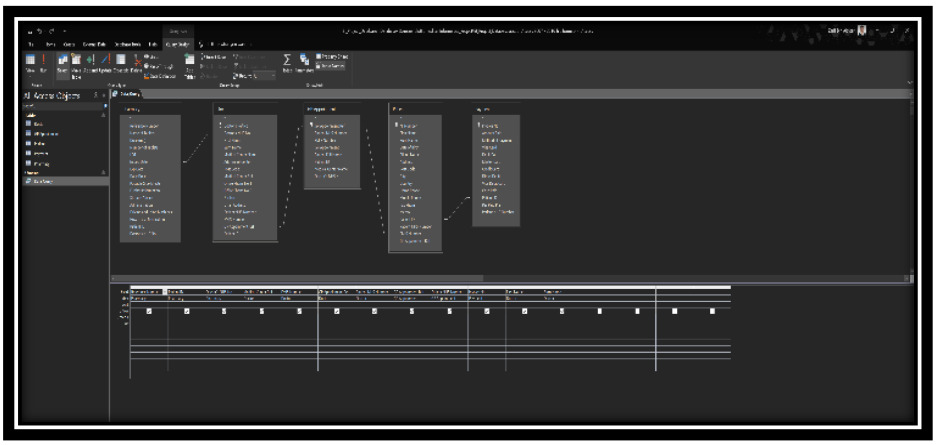

Figure 7. A Schematic Visual Representation of The System Database Config

The data table attributes were speculated and emulated within the server system and also the prototype system. To make it proficient a specific ID number will be generated for each user from both doctor and patient end. However, this number will be generated inside the source code of the prototype system and based on requirement and priority they will be appointed to doctors and patients so that no data duplication and redundant data or misplaced data recurrence doesn't take place.

When a patient is diagnosed by a specific doctor and has received medication from that particular doctor if they wish to, they can share their ID number with one another. If provided by both, they can search for the particular user from their respective portal end. But it will depend on the doctor and patient individual integrity and their own personal decisions. Unless they share their information, the system will not provide the generated ID to neither user's end. This is to ensure data privacy for both users. Every patient will have their own choice of interest and based on what they intend to share, the system will perform accordingly.

Along with that, the fields will only store the data inside the system only when the user saves the information in their respective portal profile. So, the decision is based solely on each and every individual selection and it completely depends on the respective user. The uploaded files for medical reports or diagnosis will also be saved only when a particular patient provides them into their portal. The patient will have the scope to update, alter information in their patient portal profile. But in order to get the maximum amount of output and best results possible it will be advised to both users to provide as much information as possible. The designed and developed prototype was integrated with the mentioned features and functionality utilities in the context of the research and each layout represents its particular set of aspect. Each of the layouts can be altered and updated based on user requirement. The idea was to represent a segmented view to the user end so that the individuals can use the layout with much ease of comfort and ease of access. Both doctor and patient have their own personal profile layout individually and each layout serves specific functionalities for the respective users.

Some matters to point, the doctor and patient data can only be provided to the system when one enters and registers their info and gives permission to save them in the data storage. For clarity of privacy the doctor can only view patient data for medical history concerning any patient but

cannot edit nor change information for any patient. Only the patient can edit and add their medical history if they wish to provide data to the system. But each patient must also bear in mind that, if misinformation or disclosed data are provided it can result into a wrong medication for them. Because if on any particular disease if any patient wishes to not provide sufficient data that is not a fault in the case for a doctor because the Doctor will provide a medication or solution based on the data that particular patient will provide. That is why it is of upmost importance that the patient provides all the necessary information required.

As mentioned, the patient has the scope to update and alter their information inside the system along with attachment of medical documents. But please bear in mind, the patient must include the original and authentic data inside their portal and only the patient has the ability to share and disclose the matters with their perspective and selected doctor. For wrong entry of data and reports with medical documents the blame will fall upon the patient as the patient is in charge of to what extent of data, he/she will provide or wish to share. The doctor will not be responsible for the misinformation provided by the patient. As no doctor has access to edit or alter any information for any patient inside the system. The doctor can only view patient data and unless any patient provides their attachments of documents or data for sharing, no doctor has permission to access the data.

Also, if any patient does not fix any appointment with any particular doctor or access his/her profile the doctor won't even see the patient entry from their respective portal. On this context, for appointment purposes, the patient must select and confirm the time frame from the patient end. This feature also provides a great solution of communication between the patient and doctor as there are no other parties involved. This maybe an issue for some hospitals and organizations but everything has a good and a bad side. Sometimes due to miscommunications from different parties involved which usually results in wrong treatment. But this system provides a direct communication protocol between only the patient and doctor. During research and survey conduction, it was very much evident that many organizations were against this idea as it makes a loss of profit to some degree in context to various individuals. The patient cannot hold any doctor accountable if the patient fails to meet the given window of timeframe selected by the patient. The patient can view the list of doctors and their availability of time from the doctors list tab and select accordingly. If required they can contact the hospital or the doctor if the doctor provides that information. One fact to mention on this retrospect, the doctor list view can only be accessible if the doctor or a particular hospital gives information inside the system. If it is disclosed and not shared the patient will not have access to the doctors list or hospital information. The decision on this matter depends on the hospital or doctor involved.

To provide a better understanding in this context would be the fact that, a bridge is only as strong as strong are its pillars. In terms of medical clinicians many are not a fan of this system due to the accessibility of the system. One must understand that, in order to make an output, input data must be provided first cause without proper data no classification or model can be deployed or developed if there is shortage of information. In Bangladesh the communication gap between a patient and a doctor is something very rare to see as there is a huge mistrust between the two.

For any system it is of immense importance to visualize and graphically illustrate the functionality to its associated users. When that perspective revolves around human health and anatomy check, the usage access and interaction have to be segmented to each specific constrains and attribute of objectives. Such measures were taken for this research scope prototype project as well.

There are many matters which require an ethical approach from both doctor and patient end to finalize the full retrospect of the tremulations and processing which will take place and might be taking place in real-time dynamics. A patient personal information is a sensitive case scenario and has different obligations in terms of debate to a particular issue or diseases. It must be understood that, human emotions and aptitude also will impact on the scaling of understanding towards communication and therapy consultation or counseling. As mentioned, the data information and attached documents upload and share will be ease of access from patient portal and it will come in formation of how an individual patient will approach to the context of this matter.

The system will give full access control to patients for storing and retrieving their personal data and content. The patient can alter and change their information in real-time graphical layouts. But it should also be realized that, any individual doctor cannot consult or give suggestions without knowing the full backstory and medical records history of any patient. The proper and factual solution on this context is the collaboration and understanding from patient and doctor from both ends.

One may argue that, different doctors will have various opinions with an imbalance in senior and junior with experience interpersonal skillset & prospect of view and see the matter from various angles. True, in the case for many scenarios, but one fact must be understood that, at the end of the day we are all humans and mistakes may and probably will occur and problem issues will rise but instead of creating unfortunate misunderstandings we should think for a solution and act accordingly.

During the survey it was queried that, the doctor list layout provides patients to various doctors and individuals of same fields may find each other on a particular matter. A patient may choose to see different doctors for a same disease's solution. If the patient shares their previous medical documents and reports for a concurrent doctor checkout to a new doctor there might be some issues presented. As many doctors themselves have answered that, different skillset and experience for doctors vary when making decisions on a particular assessment and consultation which can create rifts and miscommunication among various doctors. But as a user and as an understandable human being it must be understood that, doctors are human too and slight errors and inconsistency will rise but that does not mean it cannot be solved.

To provide a clear concise and ethical approach to the matter, the system was integrated with a regulation agreement when doctors or hospitals will provide their contact information and diagnosis consultation and medication of instructions. By providing doctors information in the doctor portal the doctors agree to the fact that, they will take all case scenarios into understanding and provide solution based upon ethical and moral decisions and reasoning considering the human-patient perspective.

7. PROTOTYPE DESIGN VIEW AND USER'S PORTAL

Concerning the EHR implementation, in the case of Bangladesh, it has a lot of variety of issues from various perspectives due to involvement of many aspects of matter both from government end and a political standpoint. This research scope was downsized due to those many factors in the case concerning the Bangladesh Medical landscape of area and government and its community of people from a country aspect. However, there were also many positive significances from the perspective as well since many people saw this as an amazing technological digital upgrade in the health administration of public health system and safety with a touch of modernization. The design user portal with its associate functionality and features are illustrated within figure 8-15 and in figure 16 a visualization of EHR benefits in the last decade.

Figure 8. Login View of The System

Figure 9. Doctor Login View of The System

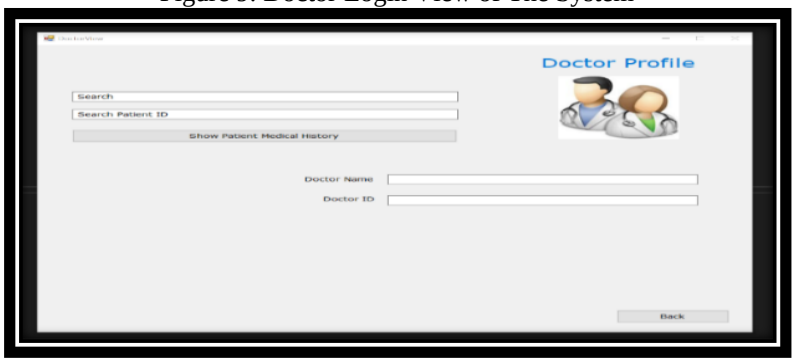

Figure 10. Doctor Profile View of The System

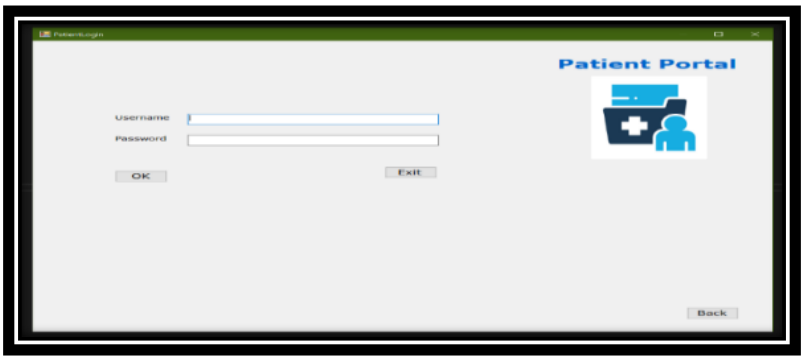

Figure 11. Patient View of The System

Figure 12. Patient Portal Profile in The System

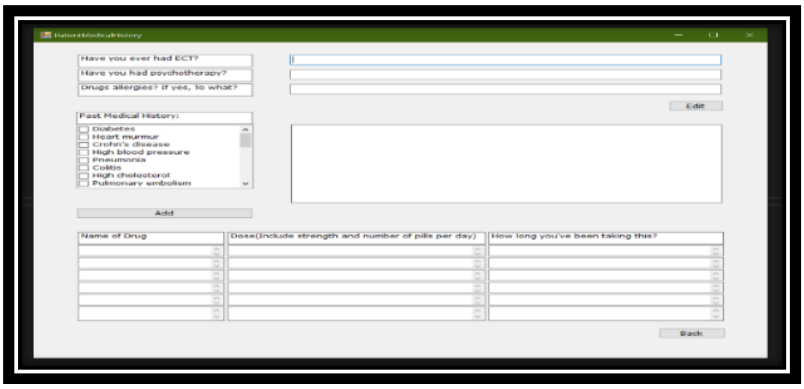

Figure 13. Patient Medical History Layout in The System

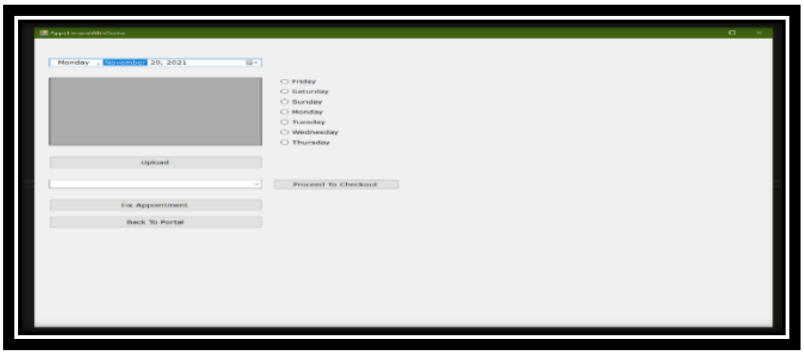

Figure 14. Doctors List and Appointment Portal Profile in The System

Figure 15. Payment Portal in The System

Figure 16. A Visualization Of EHR Benefit View in The Last Decade

8. RESULTS AND FINDINGS

With per accordance to all the features and functionalities the prototype was tested with various individuals both from patient and doctors end in retrospect to a user experience perspective. Each speculated render and research data collected from usage of access was formulated to a visual representation with the context to an ethical approach for a better understanding. One can certainly argue and point out to the fact that, EHR will be one of the great innovations in terms of health systems and an amazing toolkit for the medical sector. But it can also be argued about the fact that, if there is so much lack of understating from country perspective what will be the point to undergo the need for its deployment.

Maybe today it might not be evident and meaningful but in the near future this might be sought out for development and deployment. The pandemic was a prime example of why such advancements are required and how innovative their impact will be in the coming years. So, there is hope and as a developing nation it will eventually take place. This research provides a clear insight and bridge gateway to that pathway.

Health is and always will be the root apex of priority considering the human anatomy perspective. The scaling and fusion of diseases with new variants of mutation and risk of anatomical decay health concerns must be given the highest concentration to careful research and constant improvement. The smallest of improvement can minimize any heath issue to any extent of recovery and better treatment for patients. So, the updating and consistent alteration for usage of access will forever remain stagnant in the realm of health and science in terms of human anatomy.

The approached research and prototype render creates a pathway to that vary aspect in line with human health. But like any other form of medication or health solver many matters rose during the conduction of the research experiment. Like any matter, there will be both good and bad points of view. Despite that, there are various attribute features which makes the prototype very unique in terms of human health science innovation.

9. DISCUSSION AND CONCLUSIONS

In the domain of medical science and biomedical engineering there are still various perspective and process of innovation which still requires a new outlook based on the medical history and its associated documentations. The EHR system can be the direct entry in line with that retrospect if utilized properly. Health concerns still remain at large with a huge chunk of vulnerabilities and threatening situations being consistent at every pace of human life cycle. In the context surrounding Bangladesh where people in the recent years have suffered more severely and was devasted in terms of diseases rise and the miscommunications in between the hospitals, doctors, patients, government has showed how vulnerable the medical system still is in this digital era of modern systems.

There are many drawbacks to the idea for EHR system management utilization but after the COVID-19 pandemic that mindset might alter and the country along with the people concurrently may understand the need and fully grasp why such a system is relevant in terms of human health. This research was aimed at the very same idea and conceptuality towards that goal. Hopefully in the near future this unique prototype design will be developed further and deployed at a global scale and make an impactful contribution in the medical systems and human anatomy. However, this research was put on hold when the author had moved to the foreign landscape for higher education and research. But never the less this research scope was a unique deployment in terms of medical system and health innovation. And hopefully in the future this will become a project reality in a global scale. On that regard, only time will tell how it will shape out in the near future.

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author developed and updated the research as per mentioned in the context of this research paper. But after when pandemic began to normalize the author had gone for his higher studies and as a result the research was put on hold till further confirmation from the author himself.

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