A next-generation telemedicine and health advice system.

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2021

A Next-Generation Telemedicine and Health Advice System

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Abstract. This project aims to create a real time health advice platform and telemedicine system that can reach healthcare providers and healthcare deprived people. A pragmatic approach is being used to understand the research problem of this study, which allows all the authors to recognize diverse concepts and clarifications, as well as understanding the research problem and quality. The initial primary research has consisted of three sections: planning, configuration, and reporting. We have identified the users and modelled our system based on their geographical location, age groups, literacy, and diseases. We also identified that some of the continents are far behind in health information technology research, where 37% of work is carried out in the USA, 24% in Europe, 15% in Asia, 3% in Africa and 15 % in the rest of the world. We have further tracked out that most of the low and middle income countries' populations have less technological knowledge, where 60-70% are uneducated, 20-30% are educated, and only 10% have higher education and experience. We have considered these data sets and developed a sample web, IOS and Android based telemedicine platform that includes various functionalities including video and instant messaging, and social and educational posts for all types of users, e.g., doctors, nurses, and patients.

Keywords: Telemedicine, Digital Health, Distant healthcare, Clinical Decision Support Systems, Electronic Health Record, Health Informatics, Software

1 Introduction

Clinical decision support system (CDSS), a crucial part of the electronic health record (EHR) is a mechanism to enhance health related decision making. The evolution of these systems started in 1990 and was described as 'state-of-the-art'

by the worldwide researchers [16]. Therefore, Healthcare Information Technologies (HIT) and the Health Informatics Application (HIA) are playing a shared role in many aspects of healthcare services, including decision making and have created the fourth industrial revolution "cyber-physical systems" [3] [15].

The recent development of precision medicine [1][2] and implementation science[2] are the critical concepts of specialist CDS to get a patient tailored prescription [1]. Subsequently, the progress of CDS is constructing upon decades of work [7] [16] through data generation, to aggregation, analysis, knowledge creation, knowledge dissemination and use, and ongoing measurement for continuous feedback and refinement of the systems by the global initiatives [6] [9]. Thus, a CDS with distinct proficiency of specialist disease and medicine is a necessity in modern healthcare settings [5]. Hence, the growing challenges within this sector are restructuring the related technology by creating turn key solutions for capturing a series of medical 'Big Data' and Artificial intelligence (AI). At present, the concept of mimicking human intelligence is delivering benefits in some medical domains [10] [18]and other domains. But still, there is a visible lack of human intelligence, and some of the models have a lack of explicit declarative knowledge representation which needs improvement [10][11] [18].

However, these days, people around the world can get medical advice from a personal fitness app or to check the status of a drug dose from a separate geographical location by Internet linked communication, fiber links or 3G, 4G and 5G network. In the app stores, there are more than 165,000 mobile health apps publicly available, which is producing 2.5 Exabyte of data every day [4] [14]. There are a considerable number of Internet of Things (IoT) devices connected to the health sectors and the personal user level than ever before [8] [19].Hence, the categorisation of apps and their contents is based upon the decision of the developers. Sometimes this information is not reliable and useful to the users. These massive volumes of apps and embedded information are frequently fragmented and have the absence of appropriate references and supportive scientific knowledge [17].

In this work, we have developed a portable, user friendly and web based health monitoring and supporting system named ANGTHAS. This system can reach health care professionals, clinicians, health care providers to the people who are deprived of health needs due to various reasons like a socioeconomic barrier, language barrier, and geographical barrier. This system interconnects patients and doctors from all over the world in addition, other health related services like ambulance, emergency response etc. These web and apps based platforms will integrate various tools like self diagnosis screening through uploading own health data, offer voice and a video chat platform for live consulting with a

[1] Precision medicine is a specialised approach to the individual patient care, which allows clinicians to tailor and select a most likely treatment to help patients based on their genetic understanding and disease. It is also called personalised medicine

[2] Implementation science is the study methods of the LHS to recommend the implementation and integration of evidencebased practices, involvements and strategies into routine healthcare and public health settings.

health expert, real time messaging and communication system, a portal which demonstrates various health related information and guidelines. Also, different technologies like mobile computing, distributed computing, IoT network has been utilized to remotely measure and collect patient's data.

In section 2, we review the existing literature related to our project and discuss the limitations and shortcomings. In section 3, we explain the research methodology, including literature search strategy, requirements analysis and system design. Section 4 shows the results and discussions. In section 5, we illustrate the initial prototype, and finally, section 6 concludes the paper.

2 Research Methodology

A pragmatic approach is being used to understand the research problem of this study, which allows all the authors to recognise diverse concepts and clarifications, as well as understanding the research problem and quality. Thus, the methodology was formulated by the findings from the initial literature review, key and the additional research questions.

Key Research Question How can a health advice application be integrated, combining AI, Machine Learning, Natural Language Processing?

The abbreviation of the 'A Next-Generation Telemedicine and Health Advice System' is ANGTHAS, and from the beginning of this research, we have followed a structured methodology. From design to build, we have analysed every stage and understood each need. We have divided it into three sections, 'Stage One' for the initial research, requirement analysis, low level prototyping. 'Stage Two' for extended study and built the application. 'Stage Three' is the final stage of the first round of the research. The initial 'stage one' 'the primary research' has consisted of three sections: planning, configuration, and reporting.

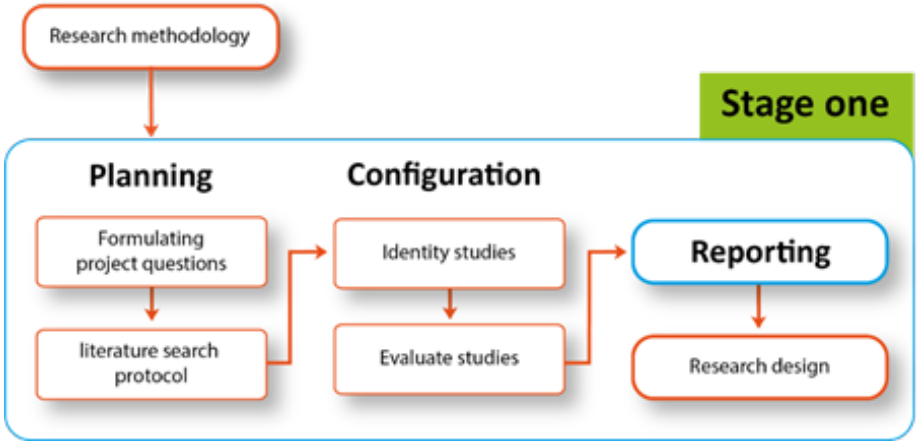

Fig. 1. Research Methodology Stage One

2.1 Literature Search Strategy

The University of Portsmouth library database, Google Scholar and PubMed data base are used to identify relevant published papers. All of the databases are well established and have a wide range of peer reviewed journals information and are always kept up to date. An effective literature searches strategy were developed by following 'A structured approach to documenting a search strategy for publication' [13] framework.

2.2 Requirements analysis and system design

ANGTHAS is a combination of many systems, where our priority is to develop a system including most appropriate functionalities for different nations, age groups, literariness and diseases. For our second stage research, we have followed a series of following planned activities.

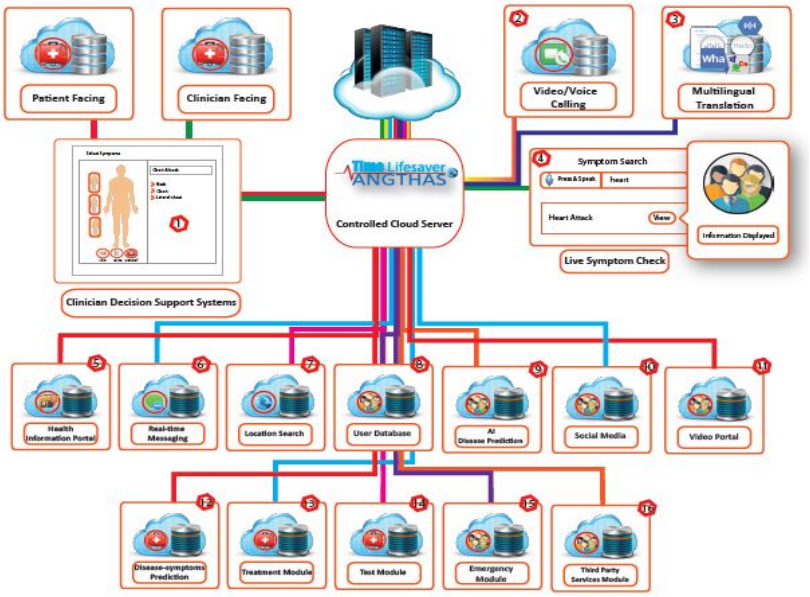

Fig. 2. ANGTHAS System map

Requirement Gathering and analysis Here, all possible requirements of the system to be developed are captured and we have called it HCI analysis; we have categorized different level's user type, i.e. Doctor patient nurse and mentioned their respective functionalities. Various services are included, such as pharmacy, test centers, and others. We have also documented how these entities will interact with one another.

System Design Here, we have specified and defined hardware and system requirements. We have to represent entities from the requirement phase. Then we build up the relationship among them, like a medicine drug type relationship where one drug type can have many medicines or disease symptoms relationship many diseases can have many symptoms. Being a health informatics system, we emphasised mostly the real time emergency solution if any emergency users can directly make contact with service providers as per the location. We have followed the RDBMS (Relational database management system) so that our data will remain in a structured format. In the future, we can implement Machine learning models utilising or mining these structured data efficiently.The following figure 2 represents the system diagram.

Implementation With inputs from the system design, the system is first developed in small programs called units integrated into the next phase. Each unit is developed and tested for its functionality, which is referred to as Unit Testing.

Integration and Testing All the units developed in the implementation phase are integrated into a system after testing each unit. Post integration, the entire system is tested for any faults and failures.

Deployment of the system Once the functional and non functional testing is done, the product is deployed in the customer environment or released into the market. We will continue to research in the context, and further changes will be added after each of the test phases.

3 Results and Discussion

In "the use of health information technology in seven nations", the authors described the percentage of EHR Used in the United States (US), Canada, United Kingdom (UK), Germany, Netherlands, Australia, and New Zealand (NZ) [12].

Table 1. Electronic medical record use in the seventh nations [12]

	Aus	Can	Ger	Neth	New Zea	UK	US
Primary care							
EHR(%)	79-90	20-23	42–90	95–98	92–98	89–99	24–28
CPOE (%)	75–81	20-23	42–90	95–98	92–98	89–99	24–28
Hospital Care(%)							
EHR(%)	< 10	< 10	< 5	< 5	< 10	8	N/A
CPOE (%)	< 1	< 1	< 5	< 5	< 1	3	510

It is also identified that there are numbers of technology revolutions in the published literature. The AI published literature is higher than the other categories, and among them, 37% from the USA, 24% from Europe, 15% each

from Asia and other (i.e. collaboration between countries), 3% from Africa and 6% from the Middle East. It exposed several themes in the present healthcare technology to grow the HIT maturity such as AI and robotics, virtual reality, ubiquitous healthcare system, IoT and Big Data, care pharmacy, e-Health and m-Health.

We also identified that some of the continents are far behind relation to HIT research and development. The following chart will forecast the HIT development and research work in Asia, Africa, Middle East, Europe, USA and other (i.e. collaboration between countries) to understand the aspects, where 37% of work carried out in the USA, 24% in Europe, 15% in Asia, 3% in Africa and 15% rest of the world.

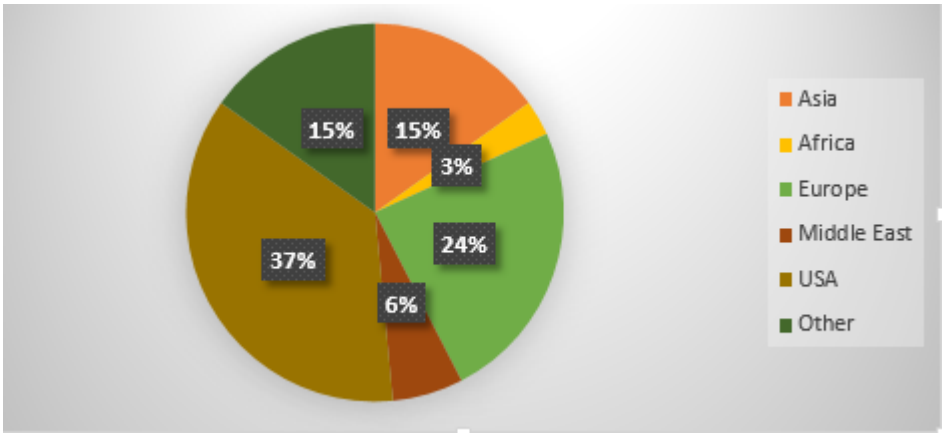

Fig. 3. HIT research and development work by the global community

4 Observations of the initial prototype

We have developed a sample prototype for web and mobile application to test our thinking as well as to recruit researchers and developers to understand the settings. The sample application has most of the functionalities of the proposed systems. ANGTHAS is hosted to the www.worldhealthaid.org domain, and we named it WHA (HA). In this model, we have the social tab, blog tab (for medical information), a portal (problem solve and education) and a donation system. A user can also change language to his preferred language. A text field titled medical dashboard is added where any user can share his thoughts and posts.

5 Conclusion

Geographical and socioeconomic boundaries are restricting factors for maintaining the healthcare system. Thus, we have presented an astute way to access

medical support with the help of the telemedicine system. This project aims to build a real time health advisory network that can reach out to healthcare professionals and people with disabilities and discuss conflict zones and areas that have been victims of natural disasters. By adopting the outcomes of this project, an international organisation such as the United Nations, World Health Organisation, Commonwealth, European Union, SAARC or any other inter governmental organisation can boost its capability to reach the mass population.

The proposed technology and the research technique will help it to establish a world class technology achievement of its kind in CDSS and telemedicine. It will be a mix of live patients and physicians facing a decision making support structure. Established platforms can provide paid/free advice services, such as self diagnosis screening through a combination of video/voice chat, multilingual instant translation services, instant voice command keyword symptoms search for users, real time messaging, recording contact, and a portal with health related interactive information.

The proposed project will have a significant impact on the UK and global population. The long term impact will be to contribute to the UK and global AI initiative, which will benefit citizens and care practitioners locally and internationally to detect disease in a short time to save lives, time and money. The medium term impact will be to build the UK and international community with the NHS at its heart. That will benefit UK citizens and patients/users of the NHS and social care, clinicians of all professions, UK health industry and academia. The recent several natural calamities, the war in the Middle East, and the current COVID-19 pandemic are also justifying the need for a system, where people can get help regardless of their ethnicity, position and geographical boundaries. Even at the beginning of this year, we did not know that people would need to self isolate themselves to save their lives.

The next stage of this research is to develop the web and mobile applications by improving the architecture more tailored to the user's needs. It will mainly focus on the previous study from the initial stage of the project to find out the gaps in the literature to identify the need to improve the prototype system. We will also work in individual groups to develop a different type of disease prediction and forecast modules, like diabetics and phenomena prediction.

6 Acknowledgement

Partial funding to initiate some of the research has been received from the Future & Emerging Technologies Theme at the University of Portsmouth and the Global Challenges Research Fund (GCRF). Time Research & Innovation is the other commercial funding source for this study.

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