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Tech driven wellness: centralized integrated health management system in UAE

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ABSTRACT

With the ever-more increasing usage of technology in our day-to-day life, an incursion into healthcare has been warranted. Especially in today's age, where you have digital trackers all around, confusing terms of service, and just in general difficult management of healthcare. HealthPulse seeks to revolutionize that and simplify the concept of healthcare to the simple person. This will be accomplished by integrating the application with the Emirates ID, in the United Arab Emirates, and granting access to various insurance and past records. Additionally, it features a section for early diagnoses and standard measurements, in addition to extensions and plugins to be provided by third parties. Using biometrics will apply in the implementation for the creation of a secure digital national ID and enhancing the merger of public. Machine learning framework, which is trained on a dataset of images of certain diseases will be able to differentiate between a healthy and inflicted cases.

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1. INTRODUCTION

Traditional Healthcare has existed for as long as the very system of healthcare has existed. It has been the go-to protocol for quite literally any issue that upholds a community in any location. A linear system bounded by protocols and operations, which is not very well suited to the modern incarnation of healthcare, has evolved to become exponential in speed, changing dynamically by minute [1]-[3]. Whether you're in your home country or abroad. Despite that, healthcare is one of the most deluded and confusing aspects of anyone's life, with confusing insurance policies, rampant records, complicated appointments, and much more. Many individuals around the world have voiced their dissatisfaction with the current state of healthcare and its predatory disorganization, both on the patient and even the staff side [1]-[8]. It's been reported that a great number of people would prefer to better understand their insurance policies, information, system, and costs, as many of them are clueless with regards to that [1], [9].

Medical Insurance, one of the most jalopy terms to exist, to the point that even individuals working in healthcare lack appropriate knowledge, which is fueling a culture of doubt and confusion, resulting in poor outcomes [2], [10]. There's also been an issue with hospital appointments, both from the administrative disorganization side and the patient side, with the prevalence of no-show appointments, which massively impact the efficiency and reliability of a certain system at any given time frame, and most importantly wastes medical resources and affects the overall sustainability of a system [2], [9]. The combination of these predatory behaviors, confusing policies, broken systems, costs have been a deterrent to many patients

receiving proper treatments, and just generally making the experience much more difficult to undergo from a healthcare point of view. One must keep in mind that there is a modern dynamically changing environment in this century, where a traditional system is not going to be able to withstand any influxes or additions [10]-[15]. Many have acknowledged the natural complexity of the modern healthcare system and have sought to propose some solutions. According to [12] which has made an observation regarding the shift of healthcare from a more traditional point to its modern incarnation today, where in the traditional approach, problems could be split into incremental steps. Although due to its complexity, order of operations, paradoxes, unpredictability, fuzzy boundaries. The author recommends embracing the framework of adaptive systems theory, to try to manage healthcare complexity, as well as shifting from linear problem solving towards more dynamic methodology, these linear methods being implemented by certain protocols in place for anything taking place. The author provides an excellent exploration of the problem, whereby the author takes multiple factors into account, and this showcases the system point of view towards the overall problem of healthcare complexity. On the other Hans, it was presented in [13] a similar approach and considers the increasing costs and the poor quality of healthcare that is being given that is a product of linear thinking and lessening innovation. It proposes a solution where leadership must be transformed into an organized collaboration system with innovative mindsets behind it. This should be able to reduce the complexity and cost, while increasing the quality.

In addition to that, the study presented in [14] takes a more technical look at the overall issue, by proposing using actor-network theory to address the complexity of healthcare, where this treats both human and non-human actors equally which allows for stable exchange, directing analysis into unfolding actions and using it in healthcare research. This, ANT which can reduce complexity and flowize the output of analyses, which could prevent healthcare collapses due to disorganizations and mix-ups. All the previously discussed works take a more passive approach, while [15] aims to embrace complexity. The research states the need for a massive shift to recognize and address the growing complexity that all have brought up, and a decision-making paradigm to navigate the complex environment of healthcare. The research also dives into failures that have come due to the in-acknowledgement of the mere complexity of healthcare. The research also dives into failures that have come due to ignorance of complexity, similar to some ideas mentioned in [16]. The study in [15] aims for a generalist approach, a patient-partnered system which can better assist the patient. The increase of sustainable and scalable solutions, openness, and situational awareness which can increase the efficiency of the healthcare system.

All the previously mentioned works take a dive into the same problem of healthcare complexity, deeply rooted in various things, ranging from traditional mindsets to confusing policies. Healthcare is diluted by a product of all the previously brought up issues, and there have been some solutions proposed by the 3 previous works, for example, [15] proposes adopting complexity-oriented tools, creating antifragile systems, and empowering patients. Research [14] proposes using Actor-Network theory which mainly dives into the technical aspect of the overall issue. All of these are bright solutions that have an end goal of reducing the overall complexity of the healthcare system. Khalil [17] interestingly explores multiple solutions for chronic care systems, which are a bit more directed but still provide an important insight. Despite that, some of them are not applicable in real life, and might be a bit too ‘optimistic’ or impractical, lacking proper analysis. Meaning only available in a ‘perfect vacuum’ environment, and might even further the complexity of the overall healthcare system. Another issue is the patient side of things, that isn’t always addressed. It is minorly addressed, such as the concept of confusing insurance policies, but not much depth is provided. Thus, much more focus on a patient-central system is required. This is where the preposition comes in. Multiple works have explored the actual problems of healthcare, and proposed minor solutions that are split from each other. The truth of the matter is that a middle approach is most likely the best approach seeking to combine all these solutions to simplify the experience for both healthcare providers and patients involved in the overall loop.

All the previously mentioned issues can be mitigated by centralization of healthcare, which is what we seek to deliver in our application, by applying the following features which we will dive into in detail later on. HealthPulse seeks to make gaining access to the system simple, by implementing UAEPass, then providing a holistic central health portfolio which shows the user the status, and an overall medical profile that includes bookings, current medication, and anything of that sort [1], [5], [6], [9]. There is also a smart medication aid system that keeps track of medication for the user and can check for counterfeits that can cause harm to life [3]. The beta application also supports Addons and plugins such as vitamin deficiency detectors and much more, which can help in early diagnosis. These parts of the program primarily address the patient side of things. HealthPulse also allows for direct patient-provider communication, which reduces inefficiencies of the system, and can reduce the number of no-show appointments. HealthPulse mainly aims to centralize and make the healthcare operation patient-focused, by having each patient as a center that is surrounded by various services, all of which can be accessed by a healthcare provider and facilitated by said

provider. This paper aims to provide a middle-ground solution between some of the previously mentioned studies, see Figure 1.

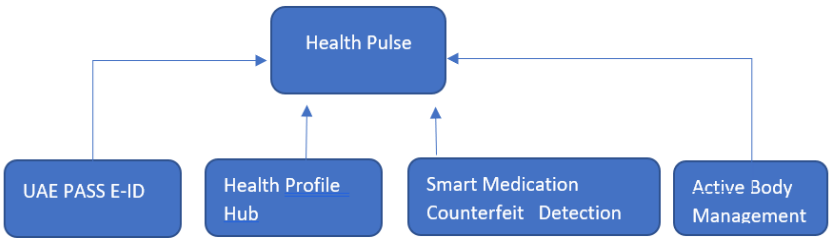

Figure 1. Digital flowchart (shows the features of the application)

2. METHOD AND FEATURES

2.1. Emirates ID, UAEPass integration

The UAEPass enables citizens of the UAE to have a digital identity to access government services, banks, telecom services and many more all in one easy to use app that has secure mobile based authentication. The emirates ID pass eliminates many time-consuming tasks as in Figure 2. For instance, the signature feature on the app can help simplify signing any official documents on people's phones thus saving time and getting rid of any need to visit service centers [5]-[7].

Utilizing the UAEPass is a crucial part of our program because it provides such an easy and time efficient way for all people at any age to sign in. Furthermore, it utilizes biometric technology [6], [7]. By using biometrics, it aids in the implementation for the creation of a secure digital national ID and enhancing the merger of public and private services. Additionally, these biometrics help in removing the need for users to create or remember any usernames or passwords. More about the UAE pass is that it is fast and very reliable in all its sections whether it is in getting access into your account or the signing feature these are all done in a non-time-consuming manner [5]-[7]. For the most part, with the increasing instances of access via UAEPass, it is beginning to be used a lot more in our daily society. We decided to have the UAE pass integrated into our application so people can have quicker access to their accounts securely without them facing any obstacles. Pursuing this strategy would require government co-operation, which would be very easy to take hold of with simple contact. The UAEPass is integrated into every device and semantic that is tied to the usage of EmiratesID, as a result, we believe that the usage of the UAEPass will simplify the whole process. Additionally, it will also provide access to insurance information and prior records, which can be fed into tools to generate certain predicted outcomes.

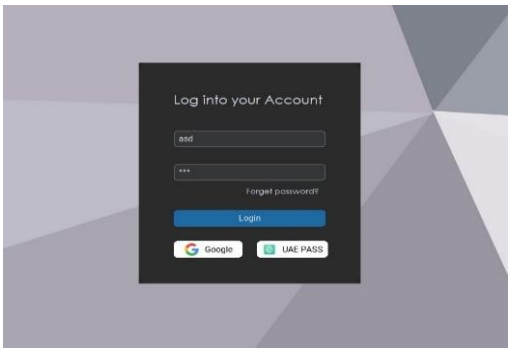

Figure 2. Sample program login (containing UAEPass function)

2.2. Health profile hub

Many people in this day in age face trouble with their healthcare. Some people find healthcare very appealing because of its complexity. There have been many discussions assembled about the aspects of healthcare whether it is in administrative or organizational part [8], [12], [13], [15]. Therefore, to achieve a developed society that will fulfil all the people's needs, there is a need for centralization of healthcare. There are many benefits that can come if we achieve this goal, one of them is cost saving and efficiency with resources, as well as conservation, and generally better provided healthcare [2], [8], [9]. Another benefit is that there is a common platform for communication which leads to the providers of healthcare to

communicate and share information easily therefore making things run much smoother without facing any complications and keeping everything consistent. Additionally, the government's involvement plays a major role that encourages deals with product manufacturers and users.

This is why HealthPulse comes in handy because it can present an overall view of your health. To give an example, in our application it displays your status and a medical profile about you where you can find any crucial documents about your health, even any upcoming appointments that are arranged, you can also book an appointment with your doctor online to remove any problems that come with manual booking. With these features and many more, healthcare can be made simpler for everyone. Said records and information can easily be collected from the EmiratesID feature and can be added to the overall profile. It can also provide a holistic view on your health information and insurance information, contributing to the development of a well-informed consumer base.

2.3. Smart medication and aid

Counterfeit medication is a big problem around the world because it causes major complications that could lead to an individual's death [3], [10], [11]. A prominent example being Tosh Ackerman, where it's been reported that he took a Xanax pill to assist in him sleeping, but unfortunately, it turned out that the medication that he took was laced with a fatal dose of fentanyl, which later resulted in his death [10]. Another incident that occurred happened to a 16-year-old who was provided with his anemia treatment, but later experienced painful muscle spasms. Following that, the family was notified that that medication was counterfeit, and it resulted in his death [11]. To help mitigate this complication, we developed a section in the app that detects if the medication is counterfeit or not. It is quite a simple feature, to be honest, as it simply scans the barcode of the desired medication, and then checks it with the correct values. This technology has been used time and time again and has essentially been integrated into the application. As the application is being used, an observation can be noted that there's a section related to providing information and guidance regarding the current medication taken. There's also added plugins that can make the application useful for the user, and assist in early diagnosis, this which will be delved into later. With the rise of artificial intelligence, and it being an ever-integral part of anything in our modern day, we have added an artificial intelligence chat bot utilizing a prompt-engineered GPT model, that we integrated into our application to assist users by providing an overview of the symptoms. Furthermore, the artificial intelligence chatbot can help you manage and fix up your appointment, and simply summarize all the information that is present in the application whether it's records.

2.4. Addons, plugins, real-time health monitoring

With the ever-evolving digital landscape, there have been many new programs and inventions that we seek to have support for in our application. Said programs could be enhancements to current features, or even a section for early diagnosis, all of that using the world of artificial intelligence [18]-[21]. These approved 3rd party plugins are meant to be designed by other developers to allow for even more opportunities for the HealthPulse ecosystem and allows for open creativity and an even better in-hospital integration. This also means that there is constant improvement, and never a lack of innovation. This also ensures a variety of features that are accessible beyond the standard features of the application.

A prominent example of this is a program that one of the authors has worked on, which is based on a Python machine learning framework, which is trained on a dataset of images of certain eye diseases such as glaucoma. Following the training, it should be able to differentiate between a healthy eye and an inflicted eye, see Figure 3. This is just a simple example, as there are a variety of applications that are on that level. Programs could later be fine-tuned to be able to achieve certain requirements [20], [21]. It Is obviously not only limited to eye diseases but could also include skin diseases and anything which can be imaged. The whole point of the program is to decrease the instances of certain diseases which can be detected by a mobile camera. So essentially, a user would provide a picture (preferably even using a macro camera which is present on most modern-day phones), and that image would be analyzed in the machine learning engine. Following that, a result will be provided and if enough flags are raised, an appointment will automatically be booked to mitigate the situation as soon as possible. This will be extremely important, especially in the detection of cancer cases, see Figure 4.

Furthermore, the program shown before uses a deep learning model, specifically developed using TensorFlow and keras, for detection of eye diseases. The pre trained model is loaded from a keras model file, which allows it to make predictions based on input eye images gathered through the webcam. Real-time detection can be enabled by using the haar cascade classifier file, which can identify eyes through the live feed. Once they are detected, they are preprocessed and normalized before being fed into the model for inference [21]-[26]. The model predicts different eye diseases from a predefined set of conditions, such as bulging eyes or cataracts, see Figure 3. Additionally, the code features a user interface with a toggle button

allowing users to showcase the labels on the feed, enhancing the interpretability of the model's predictions. This interactive program demonstrates the model's capabilities and it's use with the HealthPulse application.

It is not only limited to a program, but also integrated devices outside of the application. For example, smart watches, especially the new generation, can measure your heart rate, oxygen level, and keep track of many things [20], [21]. The application could potentially feature an integration between a smart watch and the framework itself, where it can gather information and integrate it with the rest of the data. This will further in providing a holistic view and could even foresee the introduction of an 'active' body management feature. This body management system is mainly targeted at more active individuals, or those who hope to change certain aspects of their body, for example weight or body fat composition. Following the toggle, a user will provide some data. Following that, using previous medical records, a future AI-powered adaptive tool will be given said information, and will provide daily/weekly recommendations on various things, ranging from diets to workouts.

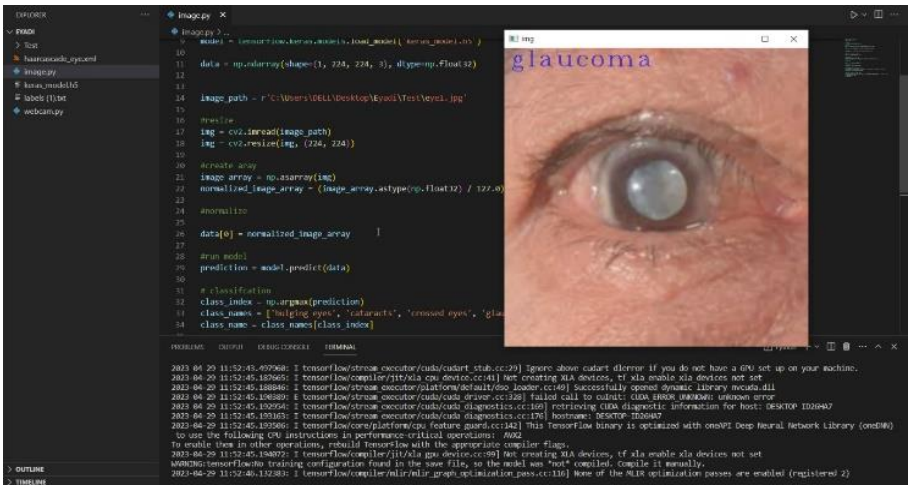

Figure 3. Program demo (eye disease detection python program)

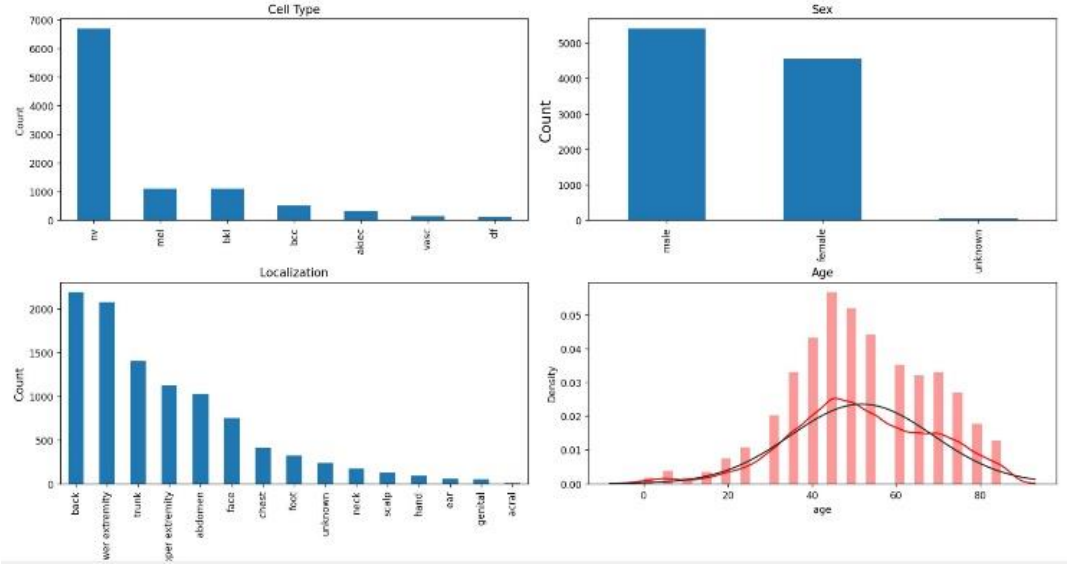

Figure 4. Sample skin cancer output, an example (data classification and detection)

3. RESULTS AND DISCUSSION

3.1. Introduction, findings, and implications

This study investigates the effects of a successful implementation of HealthPulse, which foresees a transformative impact on the landscape of healthcare, addressing various challenges and factors outlined at the beginning of this paper. Earlier papers have attempted to symphonize the very idea of centralized care by

delving into complex concepts and interwoven systems that can be labelled difficult to implement. The overall goal of HealthPulse is to revolutionize healthcare, by making it not only far more accessible, but also comprehensible to the singular individual today. The user-focused design of HealthPulse can assist individuals in engaging with their health information, by eliminating confusing terms and presenting information in a simple and digestible format, with an aim to assist users in making informed decisions with regards to their health. This is forwarded by the incorporation of user-friendly interfaces and informational navigation for general accessibility. Furthermore, this said information is centralized into one body. This provides the ability to manage health related tasks and appointments, as well as vital documentation. This increases the organization efficiency of hospitals and saves time for patients, resulting in a much more streamlined experience.

One of the application's core functionality lies in providing users with a holistic view of their health data, through seamless integration with the United Arab Emirates EmiratesID, which can be used for access through the UAEPass application [5]-[7]. Through EmiratesID, HealthPulse can gain access to diverse health records and insurance information into a unified profile. This snapshot of an individual's health history can help foster a deeper understanding of a person's medical history and can help promote active health management and informed decision making. Much of this information will be used to showcase and assist in the organization and presentation of information through a user-friendly interface. Additionally, a critical part of the application is the ability to safeguard users from the consequences of counterfeit medication, using an in-built feature that can verify the authenticity of medication through barcode scanning, adding an additional layer of protection [3], [10], [11]. Once counterfeit medication is detected, a warning will be provided and links for further education with regards to counterfeit medication, and its impact on society. This exemplifies the commitment to user safety and well-being.

With a dash of innovation, HealthPulse extends its functionalities by embracing early diagnosis programs, as well as respective plugins and addons. These serve as proactive measures against diseases that are physically detectable, such as eye diseases, skin cancer, or even vitamin deficiency with guaranteed success. That is completed by leveraging up and coming technologies, artificial intelligence, machine learning, neural networking, and much more. This enhances the role in preventative healthcare, and prompt intervention which can help guarantee a higher chance of survival for certain diseases, especially skin cancer [9], [14], [16], [18]-[21]. Furthermore, with regards to artificial intelligence, HealthPulse introduces a GPT-powered artificial intelligence Chatbot, which can provide a conversational interface for users, assisting in health-related tasks. Whether it's inquiring about health conditions, booking appointments, or assisting in early detection, its dynamic capabilities help to extend the functionality of the application, assisting users in the complex navigation of healthcare. This can also help elderly individuals or individuals who prefer a conversational style of information. The application can also be later leveraged by trainers or people planning to achieve certain body goals, via the previously discussed active body management system, which can provide daily recommendations on foods and workouts to achieve certain goals. The culmination of HealthPulse's features signifies not just a momentary solution, but a shift in healthcare management for the future. Through continuous development and a full-scale framework deployment, the long-term impact includes improved health literacy, enhanced preventative care, and a much more engaged and empowered health consumer base.

3.2. Comparison

Previous studies we have reviewed, [12]-[15] and many more have only explored and addressed certain parts or incremental parts of this problem without offering an all-encompassing solution, with a plan to action. That is not to disregard the excellent work that each has done in exploring the topic and providing an organized background, as well as in-depth explorations of certain aspects which are much needed for a situation like this. Additionally, HealthPulse is one of few who seek to address the issue of Healthcare complexity by using a centralized app, with various features. The overall approach is a bit different. Although, there is some similarity between HealthPulse and [7], with the embrace of complexity, which brings us to our next point of comparison. HealthPulse shares similarity with research [20]-[22], in some concepts, such as wearables, usage of artificial intelligence, and diagnosis systems, but then again, they are fragmented. None offers an overall solution to the general issue of healthcare complexity that we have discussed previously in this paper.

3.3. Strength and limitations

HealthPulse's strength lies in the wide variety of interpretations, and the singular linear application. It has many modules, and is designed to be open, available, fast, and most importantly, USEFUL. Out of many of the previous ideas that have been pitched, the idea of HealthPulse is of the most potential when applied and would most likely be able to fully simplify the process of healthcare to simple buttons on a

phone. Many previous papers stated that not a whole population will have access to a phone [23], [24]. These papers do have a point of view, and this limits the reach of HealthPulse to countries with a majority mobile users, meaning in a perfect scenario, all individuals would require having mobile phones to have the application. While this is a genuine concern, it is very important to remember that most of the world population has access to a phone and an internet connection [23], [24]. Other issues and concerns may simply be overridden by not completely abolishing the system of traditional healthcare. While it is complicated and linear, it should still be considered a 'hidden' backbone that still exists, in case of system failure or anything of that sort. According to research [25], there are many challenges with delivering actual clinical impact in a real-world scenario. The authors argue that so far, there has not really been any proven impact or successful deployment. Furthermore, the authors push for Robust clinical evaluation, further work to algorithms, developing interpretability methods, and improving generalizability. Research [25] brings up a great point, as that is quite true. We have seen programs, but no real-life deployments. A real-life deployment would require virgious testing as well, it is being used on living active humans. This suggests that a full application of HealthPulse can be slowed down by the general complexity of artificial intelligence, mixed with the literal complexity of healthcare [15], [16], [21], [22].

3.4. Final look

HealthPulse aims to revolutionize the healthcare industry by promoting more accessibility and understanding among people. The platform offers smooth access to full health data through its painstaking user-centric design and the construction of a centralized repository for health information. This is made possible by its interaction with systems like EmiratesID. The identification of fake drugs, the delivery of early diagnosis services, and the use of chatbots driven by artificial intelligence are examples of core functions that support proactive health care and educated decision-making, with an eye on the future, the effort is dedicated to ongoing development, emphasizing reach expansion and technical trend adaptation. Furthermore, resolving issues such as guaranteeing accessibility for communities with low mobile phone adoption rates continues to be a top concern, highlighting the platform's dedication to inclusiveness and efficiency in a variety of demographic contexts, see Figure 5 for a general overview of the application's overarching goals, vision, and ideas.

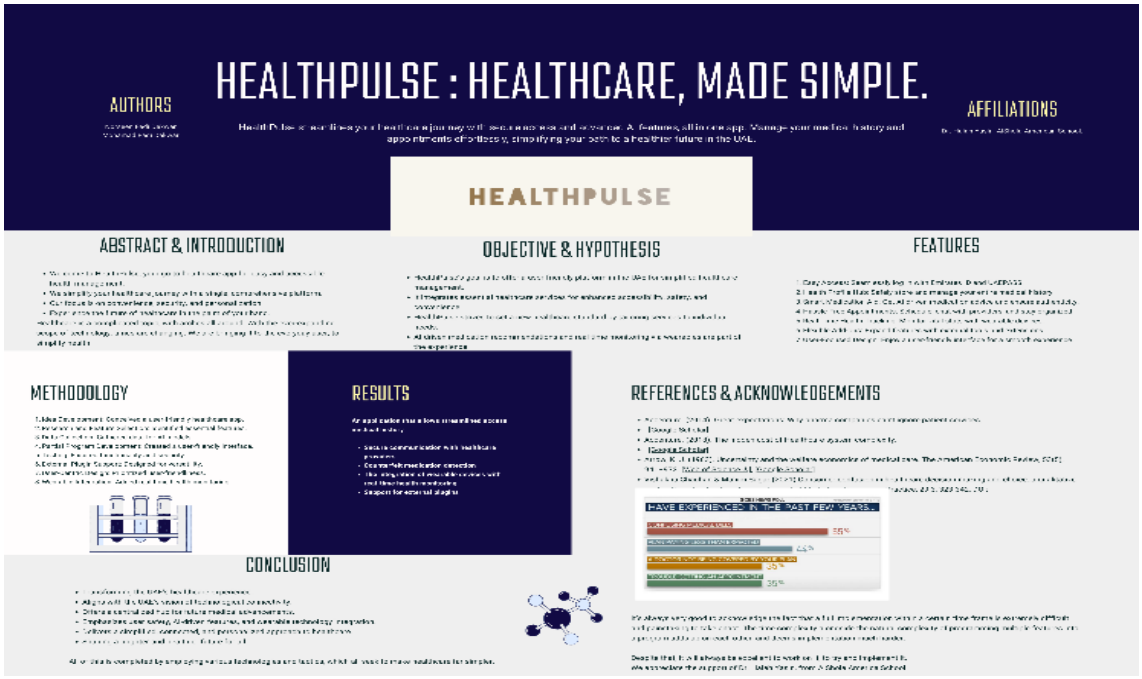

Figure 5. Overall summary (containing all the features and goals outlined previously)

4. CONCLUSIONS

HealthPulse, being a solution to the wide problem of healthcare complexity, seeks to take the middle-most approach. With a successful deployment of the framework, it would be able to eliminate most of the problems previously discussed, and despite that, it does have a few concerns and even some possible

limitations which would most definitely raise eyebrows with regards to the actual usage of the framework. The actual application of HealthPulse might seem a bit too wide, especially for hospital systems. It might be difficult to achieve globally, due to the sheer mass of a project such as this. But it is very likely that HealthPulse can be applied to a more local standpoint, such as in the UAE, which is the main preposition of this document. A full-scale application in the UAE is very much possible, as the health care system is much smaller and closed and is incrementalized to the point that an entry through HealthPulse can be completed. Many would wonder about the scale of this application, where would it reach? HealthPulse seeks to stand as an entity not just to revolutionize healthcare, but rather to inspire and direct the next generation. Future research and future are much needed for the wider research community, as this contains an overall outline of the system, with plans for application which are recommended for a smaller system, such as the UAE's Healthcare system.

HealthPulse stands tall as an exemplary manifestation of innovation, poised to reshape the complexities of healthcare management, with a forward and futuristic approach. With the rapid development of technology and its further embedment into the fabric of our daily lives, the imperative for a comprehensive and full solution to the intricacies of healthcare for individuals has never been more urgent. HealthPulse attempts to rise to this challenge by offering a designated solution and introducing a myriad of features designed to lessen the issues that arise with healthcare interactions. The essence of HealthPulse lies in the commitment to simplifying healthcare for all, overcoming the barriers that hinder individuals from understanding healthcare. With the acknowledgement that challenges may arise, particularly given the current climate of technology, it is crucial to underscore immense success. The trajectory, aligning seamlessly with the features and steps detailed earlier demonstrates that the path forward is not only viable, but it holds for impactful outcomes. The commitment to continued development remains unwavering, propelled by the belief for transformative potential. In its essence, HealthPulse signifies not just a culmination of ideas, but an embarkation of a journey where healthcare is streamlined. While questions remain about the scale and reach of HealthPulse, particularly in larger healthcare systems, its potential for global impact, especially in localized contexts such as in the UAE, is shown. Future research is needed to address these questions and further refine the implementation of HealthPulse.

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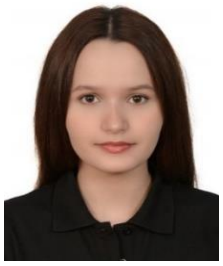

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