Artificial Intelligence (AI) and Natural Language Processing (NLP) for Digital Transformation in Healthcare

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My topic today is Artificial Intelligence and Natural Language Processing for digital transformation in healthcare. Now Healthcare is a very important area for obvious reasons and technology and digital transformation has impacted and continued to impact heavily in this area. I will talk about digital transformation in healthcare, but I plan to go dig deeper into one particular area, of how we are using artificial intelligence and natural language processing to generate value and for better patient care. To give a high-level introduction in healthcare so the digital transformation in involves the option of technologies with and, what is the objective? The goal of this is to improve the workflows in healthcare efficiency and of course patient care. And this is some information. So, I extracted from this website there can be different technologies that are brought into the part of digital transformation in healthcare Internet of Things, obviously, and the big data which is not only the volume of data itself, but there's the variety of data, the variability of the data, and so on and so forth. Telehealth is making huge impacts. It's really important. Virtual reality is being used more and more in healthcare and of course artificial intelligence, which is what I'm going to focus on. And so why do we do that? What are the benefits? I'm not going to read this out, but the highlight is patient satisfaction and engagement which is very important factor. And some more information about artificial intelligence and that makes personalized treatment possible because one of the key objectives of artificial intelligence is. To be able to provide personalized, it could be services. It could be products. And in health care personalized treatment because With the huge population that we have and it and the different needs of individuals and changing a needs it's impossible to keep track of all different variations so that. When you give services or develop products without just with manual or traditional resources. Artificial intelligence is heavily used and relied upon, and there are some figures here that 84% of industrial testing say will transform. It is definitely already transforming and it's huge dollar value. So AI power tools that expected to exceed 34 billion in 2025 and many startups and so forth. And you can get similar information from various sources, including consultancy firms research. And various industries, but I'd like to give before I go into the details of some particular AI algorithms, innovations that we are

working on in at the Center for Research Center for data analytics and Cognition at La Trobe University. I'd like to give you some context about the type of AI that is required or that is expected in the information age, so this picture on the left shows very much historical before the 1950s and so on. AI or the type of machines that work or think like humans have been around or people have been thinking and talking about their various stories and even building machines that are type of human. Like but it was in the 1950s 56s, it was actually in 1956 that the term artificial intelligence was coined and with the advent of technology and computing. AI has changed from the actual components that were built into computer programs and then of course with the so-called machine learning algorithms and with the availability of digital data in massive volumes. The expectation of what artificial intelligence would give us or can give us has evolved and changed over time, but in the current world, which is called the information age, or we call it's a digital world, there's so much more information and. Of course, we do many things and I guess we don't even know the type of information that about ourselves that we leave on various. It could be social media, it could be just various interactions, which are various technology platforms that we use. Our communications, even our movements. Because these are digital information, which is captured by artificial intelligence. The requirements and expectations have changed from algorithms and tools. Tools that are specifically built for a particular application. There are technologies which are more humanlike, or

which coexist in this information world and they can interact with the environment without direct supervision from humans. And I don't know that this is not the time to go into details of artificial intelligence, but there is a trend towards what we call the artificial general intelligence where human being is not there to supervise. And even for first of all to build. Then to adapt, adjust, monitor and then of course look at the outcomes from the artificial AI and to evaluate analyze that. So AI in the current requirements and going into the future. Is a different type of artificial being, which can coexist in the information age. Now coming into the type of work that we have, we are currently working in artificial intelligence or artificial intelligence innovations. We work on computer vision, Internet of Things including wearables, speech, analysis, facial expression, recognition and so on, and AI for managing large volumes of data. And data fusion multimodality in data. Now that's something that we have to highlight, the importance of multimodality and the ability to handle multiple modalities is really significant. Now, one of the reasons is that compared to a few years ago, there is now so many different models when you say modalities. It could be audio and video of the same situation. That are corrected and the patterns or interpretation of this with artificial intelligence will require, or the outcomes will be better. If the AI can make, use or bring these together so we call this data fusion. If the audio, the speech aspects, and the video. The vision aspects can be brought together and then that can be further validated with textual information and some other information, and such

algorithms are being built and already becoming being used. Then streams of data. It could be from videos in code from IOT, and so on, and so forth. But there's all this work happening, but today I'm going to specifically talk about some very interesting work that is currently happening about emotion capture and modeling with text, social media videos, and so on in our research lab. Why do I go into this particular area? Because I thought we not only have developed some real innovations in this, but we are also currently putting it into actual use with the Australian as well as international collaborators. And it gives a sense of the value. The benefit that this type of AI and natural language processing can bring us. So there are several very interesting projects where we are using artificial intelligence, health, technology and definitely fit into the digital transformation in healthcare. I've listed out three projects here. The first one is called artificial Intelligence based Co facilitator. So, in collaboration with the particular Healthcare Institute called Resource Institute and University of Healthcare in Canada. Communication with online patients using artificial intelligence technologies and two other projects. NHMRC stand for National Health and Medical Research Council funded. Projects from in Australia. These are Australian government funded. Projects where we are building artificial intelligence based or empowered technologies into stroke recovery of patients. So this is the first one is about personal line stroke recovery and rehabilitation through new technology for people living at home. Now the living at home part is really important because this is something really valuable that technologies and artificial intelligence can benefit that can provide society instead of having to live in hospital setting. Things or having to frequently go into and attend clinical settings. The people can stay safe and healthy, and the in their own comfortable home environments using the new technologies as well as well as monitor. Or by using artificial intelligence, the communication connect the final project that the third project that I have listed here is really interesting. Some of you might be aware of the term aphasia. This is after stroke. Certain people, depending on the particular part of the brain that is affected, have communication difficulties, and it's really major problem because it can be quite young people as well and so they have the their thoughts, ideas. And so on. That's arises, but they are not able to. Right and we are working. We are working with official experts, neuroscientists in Australia and around the world in bringing in artificial intelligence, including vision, speech analysis and emotion analysis to address these. A very high level picture of one of the projects. This is they're staying connected, so and again it's important to understand that to position these particular projects and particular innovations and artificial intelligence. That I'm presenting to the overall picture of digital transformation. So these these are new technologies, new frontiers in healthcare that are being empowered by artificial intelligence techniques. So in this case we capture different sources than the types of information from mainly 3 different sources, but that we are going to include

further. So this is the current project which has currently working on and to be trialed in the next couple of months with the actual patients. So we have collected data from wearables particularly accelerometers where the patients who are in their post stroke recovery. They are wearing and then we have developed an application which is personalized. What we call experience sampling where several times a day they are prompted with the questionnaire so that we understand from their moods what they're doing, where they are, what they ate, and so on and so forth and there's actual videos where we have something it could be zoom session. Or in other cases we capture videos which capture their trials and then they are asked to do certain activities and their movement and so on and also in addition facial expressions gestures are captured. All that is brought together and there's we have developed some. The new algorithms and of course that's the you use interfaces that are developed as well. So, the wearable sensors from physical activity monitoring, personality modeling, which visualizations and so on and actual conversation from the experience sampling app and you may just and videos. We all brought together, and we are developing a central information hub. These are multimodal information fused and run through artificial intelligence-based analytics. Components in this they are the actual mobile applications which are developed which will be used by the patients. And there are cars in the home settings. And then there's a central hub where which will have which will collect all the information sources and communicate back and forth with those patients. And

finally, on the right hand side, there's the artificial intelligence, advanced analytics modules, natural language processing, and so on. So what happens is that there are four different types of apps that they'll be chat bot, social application, app therapy app. Actual therapy is provided through the mobile labs to the patients and then particular situational information and so on. What if they are walking around, they want to have somewhere with their communication that will help and assist with their communication difficulties, but the most important factor, where is artificial intelligence? The most important contribution from the actual in the applications the apps will learn the individual peculiarities of the person during use. So if once they use it for a few weeks. Each individual is different and that individuality will be captured and it will adapt and it will learn that this person cannot say these particular. Types of words and or express these kind of speech deficiencies, emotional they and they are particularly they get upset or they don't. They dislike certain types of words and so on, and the AI will help. To adapt the. It could be the chat bot, the social apps and even help in providing the more customized and tailored therapy with. This information is transferred and and this is done via individual patient. Our tasks that are developed in so this is again currently. The initial phases are done and it will start trialing this with actual patients in the near future. Visa, several of the key applications, but what I would like to present is some very interesting modules on the emotion capture side and I will skip it then say why, why emotions are so important? Because in

more in many cases what we do, what we say and who we are. Is depends on our the the OR can be represented by the emotions that we express and because of the availability of different digital sources which capture our emotional footprints, it's possible now. To build representations of these, and of course can put to good value. So for example, one of the projects that we carried out is using online. You know the forums, so there are online cancer Cancer Support groups where patients. Express various thoughts, opinions and the issues that we face and so on. And we have used natural language processing to identify the this information from hundreds and thousands of such conversations. And this information can be particulars such as age and so on. If when they are expressed or particular clinical aspects. In this case, these Gleason values and PSA's and so on, and also decisions why a particular type of surgery was and then and then of course, but interesting the last. It's the type of emotions with the current mental condition of this patient. Now this was really, you know, because we in particular cases, working with cancer clinicians, we found that the. Amount of information. And the the the the the, the, that that is expressed in forums is much more and that compared to a questionnaire or interview that the patient because it could be because they are typing this in or in this information into the forum from their own settings from home. From their bedroom and feels much more comfortable. And this was really significant with prostate cancer patients because these are men and it it's on that men don't generally like to talk about all kinds of medical issues and healthcare issues. Even

with the clinicians, while going to the forums, the clinical supplies that the amount of information, the detail. Including after effects of various drugs and the the the medications that they have. The basically expressed in the forums, but it's humanly not possible. It's not possible for a human or a clinician for anybody to go through, read through each of these. That's where artificial intelligence natural language processing has really been useful. I think in the next couple of few minutes I will just point out some interesting modules or AI innovations. That we particularly have built in into capture emotions. Now what we have done is used a psychological model called the prusiks wheel and use. This is the push six wheel. It's a psychological model of our different emotions. So if you look at so, there are eight key emotions. For example, there's joy, trust. Fear and so on. But for each emotion there is an intensity value, so there's the. For example, if it's very high it's ecstasy and serenity is the more lower level of the. Joy and ecstasy is very high intensity, similarly from so. It could be fear. Could be apprehension if it's lighter. When terror, if it's much higher. Now we have built components you with the say from the, from the conversations that they have. To capture these. And then represent this as now what we show here is for each individual, for based on their conversations we can actually capture this person. So there are these two people. One, you can see that one person is more towards terror and rage and so on. While this person is more towards more. And this is somebody with something like a bipolar, somebody who's moving from ecstasy to go. And another really important thing that we have

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done. I know that I'm going to detail, which is very different, but just giving you a highlight so you're not supposed to read all these. Texts and so on but. By capturing the actual emotions that are expressed with these. The psychological models or computational versions of psychological models over time. Because there are patients who express these or participate in these forums for several years in fact, and we can actually use something like a state transition diagram, how their emotions change over time. And so this is the different types of emotion, and this is one person over her particular conversation, and this is 30 minutes. 60 minutes and 90 minutes. How the emotions have changed and so on. So you can identify their profile. A person of who this person is, how they change. Question is. And another thing that we have done is that we we can actually represent using emotion sequence like DNA. Sequences represent our biological nature and we are asking the question can we represent the person with their emotion sequences? I will just quickly move on to so where, where, where? Where do we put this? Where does all this information and from a healthcare technology perspective? What value does it bring into overall healthcare? So our research helps to build assistive tools for clinicians. That can manage here because as you know, mental health is a huge issue and then identifications of psychological issue. And clinical interventions, awareness and one of the the biggest areas of that. Not only us, but that's really bringing in value, is mental health chat bots because chat bots are currently being is becoming very popular. And finally, I will present this is actual. Currently the the We have deployed this technologies in this online cancer care program in Canada. The the type of the emotion capturing and representation technologies and artificial intelligence that we have developed has been actually deployed in this cancer cancer chat delta that that's online cancer care program and it's already it can do real time emotion analysis and identify not only individuals. But in Group conversations, how certain people are feeling, their emotion fluctuations and so on, that enables providing more targeted and tailored care and help the conversations from the clinicians.

Thank you!