UNIVERSITI MALAYSIA SARAWAK
Faculty of Computer Science and Information Technology

Assignment/Report Cover Sheet

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Assignment Title:	Assignment	Lecturer:	Dr. Mohamad Nazim bin Jambli
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Table of Content

Research Paper Summary (1)

Title:	MedKiosk: An Embodied Conversational Intelligence via Deep Learning (Leong, Goh, & Kumar, 2017)
Problem Statement:	The use of interactive self-service kiosks through the use of touch screens has become a major trend intensively used, especially in e-commerce and medical healthcare. Due to the enormous demand from interactive kiosks, researchers have seen kiosks advance by adding an intelligent conversational agent to provide instant responses and consistent information.
Research Purpose:	To design and develop a platform to revolutionize the medical kiosks through the integration of an intelligent chatbot.

To innovate the current interactive kiosks by providing immediate responses and reliable information with an intelligent conversational agent (CA). |
| **Research Background:** | Conversational agent (CA) also widely known as chatbots is a computer program designed to simulate human-machine interactions. The term conversational denotes real-time chat communication between human and machine through auditory or textual methods. An interactive kiosk is an integrated self-service computer terminal with advanced hardware and software designed to display information and perform a variety of functions to a public exhibit. The widespread use of interactive kiosks in hospitals involves real-time interaction and scheduled appointments check-in. Latest innovations in natural language processing (NLP), machine learning and deep learning in the field of artificial intelligence (AI) ensure smarter decision making in providing accurate, reliable and up-to-date information. |
| **Research Method:** | MedKiosk prototype has been developed with the proposed framework, knowledge base and algorithm by using natural language processing (NLP), machine learning and deep learning in the field of artificial intelligence (AI). |
| **Research outcomes:** | The result of this study, the framework was designed to include a virtual speaking character that has the capabilities to provide meaningful conversation with the user. This framework works by using client-server computing. The intelligent chatbot is written using the AIML (Artificial Intelligent Markup Language) comprises the XML (Extensible Markup Language).

It also included computational models that contain several or fewer layers of processing to acquire and data representations. Similar to the concept of how the human brain functions, in a sequence staged, deep learning uses the idea of neural network with multiple layers of nodes between input and output to perform recognition and processing. It also uses an algorithm to provide training corpus to learn how to understand and interpret the data.

MedKiosk relies on the AI, specifically machine learning and deep learning to unveil the connections, algorithms, patterns and anomalies to expand the knowledge base of chatbots. Besides, the experiment would be host by placing the MedKiosk for real-time |

	data collection at the hospital. It is based on unsupervised learning approach whereby the chatbot's knowledge is improved and updated for accuracy through the machine learning or deep learning algorithm that enables the chatbot to learn itself from previous conversations proactively.
Research Significant:	This study is important as there is no medical kiosk that incorporates intelligent chatbot in Malaysia. The intelligent chatbot agent can improve hospital productivity and efficiency in Malaysia by providing the ability to answer routine and frequently asked questions besides to allow for specific searches as well as initiating a conversation. The medical kiosk would be installed in the hospital to be used for data collection in real-time settings, instead of collecting data in theoretical and analytical ways. It is hoped that with the availability of this research, the productivity in hospital can be raised upsurge besides having the user to satisfy with the service provided.
Conclusion:	The primary role of the intelligent medical kiosk is basically to assist users in accessing information and resources when they are in the hospital. This work aims to increase the productivity and efficiency of medical institutions by offering immediate response capabilities and initiating a conversation, similar to conversing with the experienced customer's service assistant.

Research Paper Summary (2)

Title:	Real-world Conversational AI for Hotel Bookings (Shi & Fazal, 2019)
Problem Statement:	Typical online travel agencies provide a web interface such as buttons, dropdowns and checkboxes to enter information and filter search, which is difficult to navigate. Next, many people book vacations using travel agents, so the idea of booking travel through conversation is already familiar.
Research Purpose:	To describe a task-oriented chatbot system that provides hotel recommendations and deals.
Research Background:	The chatbot elicits information through a conversation, such as travel dates and hotel preferences then suggests a selection of suitable hotels which the user can then book. The automated component of the chatbot is also closely integrated with human support agents: when the NLP (Natural Language Processing) system is unable to understand a customer's intentions, customer support agents are notified and take over the conversation. The agents' feedback is then used to improve the AI, providing valuable training data.
Research Method:	This research presented natural language processing (NLP) in the travel industry and used a frame-based dialogue management system, which calls machine learning models for intent classification, named entity recognition, and information retrieval subtasks.
Research outcomes:	Dialogue system can be represented as a frame-based slot filling system, operated by automation of the finite-state. The bot encourages the user to fill the next slot at each point, but it does support filling a new slot, revising a previously filled slot or filling several slots at once. Use machine learning to assist and extracting the relevant information from natural language text. It used machine learning to perform three separate cascading tasks which are intent classification, named entity recognition (NER) and information retrieval (IR). The intent model is run on all messages, NER runs on only a subset of messages and IR is run on a further subset of those. For the information retrieval system, it takes a user search query and matches it with the best location or hotel entry in the database. A few models built to manage the new types of queries such as a question-answering framework for hotels and integrating the separate models with multi-task learning.
Research Significant:	In this paper, discussion on the conversational AI and NLP (Natural Language Processing) system for hotel bookings which is currently being applied in the real world. It shows the function of a chatbot that has a much gentler learning curve since users interact with the bot using natural language and also can emulate the role of travel agents to talks to the customer while performing searches on databases.
Conclusion:	This article explains the various machine learning models that employ and the specific opportunities in the travel industry to create an e-commerce chatbot. It shows that chatbot is a viable alternative to traditional smartphone and web commerce applications. Nonetheless, the development of the task-oriented chatbot technology will have tremendous potential to enhance consumer experience and drive business growth in new and unexplored channels.

Title:	An overview of the features of chatbots in mental health: A scoping review (Abd-alrazaq et al., 2019)
Problem Statement:	The insufficient number of mental health workers has encouraged the utilization of technology advancement to meet the needs of the people who are affected by mental health conditions.
Research Purpose:	To provide an overview of the features of chatbots used by individuals for their mental health.
Research Background:	One of the main technological solutions to the lack of mental health workforce are chatbots, also known as conversational agents, conversational bots and chatterbots. A chatbot is a system which uses spoken, written and visual languages to converse and interact with human users. Chatbots have the potential to be useful tools for individuals with mental disorders, especially those who are reluctant to seek mental health advice due to stigmatization. Although numerous studies have been performed on the use of chatbots for mental health, there is need to systematically bring this evidence together to inform mental health providers and potential users about the main features of chatbots and their potential uses.
Research Method:	This research conducted by the selection of the sample and analysis of data. It finds solutions by reviewing previous relevant research. The research is done by on several kinds of a literature review published namely PsycINFO, Cochrane Central Register of Controlled Trials, IEEE Xplore, ACM Digital Library, and Google Scholar. Extracted data is synthesized by using the narrative method. Chatbots were categorized by purposes, platforms, response generation, dialogue initiative, input and output modalities, embodiment and targeted disorders.
Research outcomes:	Common uses of chatbots in mental health were therapy, training, and screening. Chatbots in most studies were rule-based and implemented in stand-alone software. The results of the research are the features of chatbots can control and lead the conversations. The most frequently used output modality was a combination of written, spoken and visual languages. In the majority of studies, chatbots features included virtual representations. The most common focus of chatbots was depression or autism. Next, the features of the chatbot that focused on embodied conversational agents are displayed virtual human characters on their screen to imitate human face-to-face conversation's main features, such as verbal and non-verbal behavior. The second review focused on both embodied and non-embodied conversational agents. Example, chatbots that only appear on screens to interact with users through texts and do not display virtual human characters but focused on some mental disorders such as depression, anxiety, schizophrenia, bipolar and substance abuse disorders. The study also discussed the web-based chatbots. Users do not need to install a specific application to their devices and reducing the risk of breaching their privacy. Web-based chatbots are more accessible than stand-alone chatbots.

Research Significant:	In this research, it helps to explore how chatbots have been used for mental health. Although chatbots were included in this analysis regardless of intent, type of response generation, input and output modalities, embodiment and targeted disorders, researchers limited their platforms to stand-alone apps and web browsers (but not robots, serious games, SMS or telephones) and restricted their type of user and device dialogue initiative (but not human operators).
Conclusion:	This research provides a list of mental health chatbots that are categorized according to their characteristics and explains the main features. There are various chatbots used for different purposed and mental disorders.

Research Paper Summary (4)

Title:	A smartphone Chatbot application to optimize the monitoring of older patients with cancer (Piau, Crissey, Brechemier, Balardy, & Nourhashemi, 2019)
Problem Statement:	Almost two-thirds of patients diagnosed with cancer are age 65 years or older. To follow up on older patients with cancer receiving chemotherapy at home, researchers implemented remote phone monitoring conducted by skilled oncology nurses. Nevertheless, given the increasing number of patients evaluated and the minimal amount of time that medical staff would spend after discharge on their patients, they had to modernize this program.
Research Purpose:	To assess the feasibility and acceptability of clinical data collection through this semi-automated solution over time.
Research Background:	Beyond the well-known and feared treatment-related side effects such as severe neutropenia and cancer treatments and more particularly, chemotherapy could accelerate the functional decline. Determining personalized treatment protocols supposes to evaluate patients' functional reserve upstream accurately. This particular concern in patients with advanced age, poor social conditions, limited access to primary care providers, or living in rural areas.
Research Method:	This research implemented a survey with a semi-automated messaging application to upgrade the current follow-up procedures. The primary aim is to collect the patient's key data over time and to free up time for nurses so that they can focus on education and care during phone calls. The chatbot feasibility was assessed in a sub-sample of unselected patients before its wider dissemination and pragmatic evaluation.
Research outcomes:	The results of this first phase are encouraging. It was feasible and appropriate to incorporate the solution into the healthcare organization. The survey result compliance rate and question completion rate were very high. The chatbot answers revealed serious health such as fever, skin rash, abnormal sensitivity and weekly blood test issues. Besides, the answers indicated problems of severe health such as fever or adherence like a blood test that need prompt intervention. The main strength of this solution is to rely on the current technology awareness (mobile text-messaging) of end-users which allows easier integration into the existing network. The data collected revealed a severe problem of health or adherence, which required timely interventions.
Research Significant:	In this paper, discussion on using smartphone Chatbot for optimizing nurses' phone calls which an artificial conversational entity running on smartphones is feasible and acceptable to collect a patient's clinical data over time and could support all kinds of home care follow-up for different purposes. Moreover, nowadays, more people are using smartphones. Therefore, this kind of solutions should become widespread in the coming years.
Conclusion:	From this research, the solution was practical, appropriate and could maximize telecare by freeing up nurses' time to concentrate telephone calls rather than data collection on training and support.

Title:	kBot: Knowledge-enabled Personalized Chatbot for Asthma Self-Management (Kadariya, 2019)
Problem Statement:	The ability to help applications like an individual's health is lacking, requiring the ability to contextualize, interactively understand and have the needed hyper-personalization necessary for productive conversations.
Research Purpose:	To design platform for health applications and adapted to help paediatric asthmatic patients (age 8 to 15) for better control their asthma. The core functionalities include regular monitoring of the patient's adherence to the prescription and recording specific health indications and environmental data.
Research Background:	kHealth Asthma is a digital system that customizes asthma assessment and management in children over the long term. It consists of a kit prescribed for one or three months to each consented patient. The kit includes a mobile health application with a wide range of wearable low-cost sensors (Fitbit for sleep measurement, Foobot for indoor air quality monitoring and peak flow meter for lung function measurement).
Research Method:	This research performed an evaluation of kBot prototype, knowledge base and algorithm to determine technological feasibility and effectiveness. An online survey form also was presented to access kBot based on user experience.
Research outcomes:	The result of this research showed the evaluation criteria such as the quality of the chatbot, acceptance of technology and usability of the program. The standard of the chatbot is divided into three categories which are naturalness, delivery of knowledge and interpretability. The kBot client framework is presented to each evaluator, and they are asked to communicate with it independently using random patient scenarios. Patient simulations reflect the interactions doctors have with actual patients. Evaluators communicate with kBot using multiple of these patient scenarios until diagnosis.

kBOT EVALUATION METRICS

	Metrics	Questions
Quality of chatbot	Naturalness	• kBot uses simple and understandable vocabulary. • kBot dialogues were unambiguous. • kBot dialogues were natural.
	Information delivery	• kBot provides patients with the right information at right time. • Information provided by kBot helps an asthma patient manage their asthma better.
	Interpretability	• kBot properly understood what a patient intended to say during the conversation. • The patients will be able to express their current asthma condition and medication usage accurately through the conversation.
Technology acceptance		• The information kBot is trying to collect through the conversation adequately conveys a patient's asthma condition. • I recommend this technology to monitor and manage a patient's daily asthma condition. • Overall, I am very satisfied with this technology.

As a result of this research, a list of asthma concepts and vocabularies such as symptoms, medication types, and activity limitation types are provided into the knowledge base. For the survey, it consists of two sets of questionnaires which are to access the technology acceptance and system usability scale.

Research Significant:	As future work, kBot prototype could improve upon a few things. Firstly, different symptoms of asthma that indicate varying severity of the disease with symptoms such as shortness of breath at rest requiring urgent medical attention. Therefore, the severity level for each symptom must be identified, and the symptoms reported to the patient treated separately. Secondly, to have a more human-like conversation, a personalized language can be built and train it on real-life doctor conversation data. In addition to environmental data, multiple IoT devices may be integrated to gather data such as indoor air quality and sleep activity to understand better the ambient environment of the patient for a more likely prognosis of symptoms that lead to worsening asthma condition. For the answer, a wider and broader variety of questions, the existing kBot knowledge base can be further expanded by various asthma concepts.
Conclusion:	kBot prototype as such a system that aware of the history of patients and has the in-depth domain expertise to produce a more accurate and contextually appropriate response for the patient. This research successfully prototyped a chatbot system that can communicate with asthma patients with in-depth background awareness and personalization to track data specific to their asthma and help them manage their asthma themselves. Nevertheless, kBot is not a medical treatment or an application for decision-making.

Comparison Table of Five Journal Papers

Papers / Components	MedKiosk: An Embodied Conversational Intelligence via Deep Learning	Real-world Conversational AI for Hotel Bookings	An overview of the features of chatbots in mental health	A smartphone Chatbot application to optimize the monitoring of older patients with cancer	kBot: Knowledge-enabled Personalized Chatbot for Asthma Self-Management
Natural language processing (Text, Voice and Audio)	✓	✓	✓	✓	✓
Natural language processing (computational models)	✓	X	X	X	✓
Natural language processing (Text Analysis that lead to Discussion, Corpus building, linguistic, semantics)	✓	X	X	X	X
Machine learning	✓	✓	✓	✓	✓
Deep learning	✓	✓	✓	✓	✓
Focused on travel industry	X	✓	X	X	X
Focused on human health	✓	X	✓	✓	✓
Ability to generate response	✓	✓	✓	✓	✓

Summarize of Five Journal Papers

Based on the above table, all five journal papers have similar components that involved natural language processing included text, voice and audio. All the research has similarities studies where conversational AI have a subset of deep learning, machine learning and also have the ability to generate responses to users.

Firstly, for the research paper titled Real-world Conversational AI for Hotel Bookings focused on the travel industry to create e-commerce chatbot while other articles focused on human health. This paper is explained how the chatbot can emulate the role of travel agents to interact with the customers while performing searches on databases by using natural language (Shi & Fazal, 2019). Secondly, the research paper entitled MedKiosk: An Embodied Conversational Intelligence via Deep Learning discussed on the primary role of conversational AI to innovate the current interactive kiosks by providing immediate responses and reliable information. In this paper, natural language processing included computational models and text analysis that lead to corpus building, linguistic semantics (Leong, Goh, & Kumar, 2017).

Thirdly, a paper titled an overview of the features of chatbots in mental health is explored how chatbots have been used for mental health and provide a list of mental health chatbots that are categorized according to their characteristics. There are various chatbots used for different purposed and psychiatric disorders (Abd-alrazaq et al., 2019). Fourthly, a smartphone Chatbot application to optimize the monitoring of older patients with cancer paper discussed on using a smartphone Chatbot for optimize nurses' phone calls which an artificial conversational entity running on smartphones is feasible and acceptable to collect a patient's clinical data over time and could support all kinds of home care follow-up for different purposes. Moreover, nowadays, more people are using smartphones (Piau, Crissey, Brechemier, Balardy, & Nourhashemi, 2019). Lastly, a research paper titled kBot: Knowledge-enabled Personalized Chatbot for Asthma Self-Management is explored conversational AI which can communicate with asthma patients with in-depth background awareness and personalization to track data specific to their asthma and help them manage their asthma themselves. Nevertheless, kBot is not a medical treatment or an application for decision-making (Kadariya, 2019).

In conclusion, conversational AI is a form of artificial intelligence that allows people to communicate with applications, websites and devices in every day in humanlike natural language through voice, text, touch and gesture. Based on the papers' summaries, in conversational AI involved natural language processing, deep learning and machine learning. Each paper has explained different topics however in a specific scope, it explained a whole architecture, features and the challenges of developing the conversational AI.

References

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