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Using Artificial Intelligence Methods to Create a Chatbot for University Questions and Answers †

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Abstract: A chatbot is a computer program that uses general rules and Artificial Intelligence techniques to simulate human conversation. This paper highlights the different scenarios of human-computer interaction and the journey it has gone through from evolution to evolvement to innovation to the development of the technical era. Here, the main focus is on the ways humans interact with the computer and how it has changed day-to-day life and reduced human efforts in performing everyday activities. There is an impact of HCI (Human–Computer Interaction) on people and has consequences in the form of both advantages and disadvantages of this interaction. The various innovations and machines have given birth to human–computer interaction as well as technology interaction. The main objective is to style the interface amongst men as well with Personal Computers (PCs) as usual as the interface amid beings. The user can interact in this system using text or voice. As per way as interaction is concerned direct, indirect, and strategic interaction of humans with computers and the latest gadgets is possible. Dynamic intelligence makes it like real-time communication with an individual. It can handle the user request and offer relevant information that can be used as a friend one would seek for knowledge. The proposed system is developed using the Rasa of an open-source platform. Further, the article focuses on the features and role of chatbots in an educational context. High precision in sentence analysis is attained with the aid of the proposed method up to a 91% hit ratio. The hit rate for the similarity computation is high. The system can handle a broader variety of requests as a consequence of its ability to recognize many ways to phrase the same inquiry and map them to related results.

Keywords: LSTM; natural language understanding; Rasa; web scrapping; chatbot; communication; RNN; Human–Computer Interaction

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1. Introduction

A chatbot is an intelligent and conversational software that uses natural language input in the form of text and voice or both. It provides the output in the form of human response also it can be used to program automatically so that they can execute tasks [1]. The concept of a chatbot is not new in this technologically growing society [2,3]. In this modern age of e-learning, it has shown interesting potential, as both a teaching and administrative tool [4]. Human–Computer Interaction (HCI) is mainly about the new and innovative ideas of the present time humans interact with the computer along with the latest technologies

involving new gadgets and software with sensors which prove to be efficiently improving life in this technology and internet era [5].

From one perspective, PC frameworks have the potential for boundless damage. Insufficient frameworks can debase personal satisfaction, and bring about financial misfortune, substantial and ecological damage, and even demise [6]. What should be done as human-machine correspondence still can't seem to get pervasive, the guidelines of collaborations among human and brainy gear essential to be sight saw, arranged that a prime example swing from Computer Mediated Communication (CMC) to Human– Machine Communication (HMC) is expected to address the issues related with speaking with brainy hardware, self-directed verdict building schemes, and smart expedients [7,8]. The chief upshot of this cooperative effort is the growth of non-hostile schemes for the incessant cataloging of cerebral lassitude that can upkeep real and effectual lassitude executive wits, particularly in the setting of counterworks [9]. Writings of a perused text introduced from a CPU are passed on to the device technologically advanced; allowing vision-impaired and challenged folks to recite an edition in the Braille layout by using their hands. Certain inventions ended in this learning with an opinion to condense the extent of the earlier advanced trial and to lessen the rate [10]. The trail to charge the gadget and its keypad for the switch trail are redesigned. A firsthand trail was shaped for the sections permitting information relocation to the Braille chambers. In the same fashion, more devices make impaired people paired and differently able people able to live a life like all the other people [11]. HCI has a mental effect on PC routine on folks, clusters, and civilization. Computer-aided education aids the significance of mainframe usage. Even the new upshots prove that by studying the undercurrents tempted in the rods, the slant and haste of finger wave can be indirect per elevation accuracy, and the scheme's efficiency permits for precise credit of finger wave and humanoid PC interface [12]. Brain-Computer Interface (BCI) is an innovative message scheme that offers an alternate network for straight conveying posts from the humanoid mind to CPUs by scrutinizing the mind's cerebral actions [13]. Certain inventions owing to HCI are EGM (Electronic Gambling Machine) which was improved using RG (Responsible Gambling) tools. Medicinal picture elucidation is poignant from two-dimensional volumetric imageries, thus varying the mental and perceptual procedures.

Understanding the various levels and forms of human interaction with automation may be done with the help of the Parasuraman et al. model [14]. Even though the degree and focal point of HCI are two various angles, there are solid covers between the two. HCI can draw on strategies and information on related fields legitimately. The design of persuasive systems can affect how people engage with computers in the gaming industry. Scarcity, urgency, loss aversion, and social proof are some of the PSD concepts that are most frequently applied in gaming. It's vital to remember that PSD design concepts may also be employed to create user-harmful systems [15]. Two ideas that are essential to Adrian David Cheok and his colleagues' study are metazoa ludens and mixed-reality interaction. For orangutans, Cheok and his colleagues have created mixed-reality games and systems that let them engage in virtual interactions with humans, other animals, and objects. According to their research, mixed-reality interaction can be a useful tool for fostering social contact between people and animals, cognitive enrichment for animals, and chances for fun learning [16].

Research on orangutans engaging with iPads in various ways has influenced discoveries in the field of animal cognition. For instance, research has shown that orangutans can swiftly pick up the usage of iPads and that they are interested in and like doing so. This implies that iPads might be a useful tool for enriching the cognitive development of captive orangutans [17]. The eye-movement information from the study by Stuijfzand et al. [18] had a variety of effects on their research. First, the data revealed that when using a BCI, users often scan various areas of the screen. This implies that training may be necessary to teach BCI users the best way to gaze at the screen for control. Second, the findings demonstrated that while utilizing a BCI, people's eye movements may be utilized to anticipate their intentions. This implies that additional user–intent–responsive BCIs

may be created using eye-tracking technologies. Third, the findings demonstrated that while using a BCI, mistakes may be detected by observing people's eye movements. The Wohl et al. [19] study looked at how BCIs may be used to identify gambling addiction. The researchers discovered that BCIs might be used to identify alterations in brain activity linked to gambling addiction. The results of the Wohl et al. study might be used to create therapies and tools for responsible gambling to spot those who are at risk of developing a gambling addiction. This might be achieved by observing changes in brain activity that are connected to gambling addiction.

The Williamson et al. [20] study looked into the possibility of controlling a robotic arm via brain–computer interfaces (BCIs). The human participants in their study had complete control over the arm for the first half of the trial but had limited control for the second. The researchers discovered that participants could adjust to the asymmetric control condition and still complete the task successfully. Bots also started to replace the website interface. IBM's Watson, Microsoft's Azure, Google's Dialogue Flow, and Facebook's Wit.ai are some commercial NLU services with generous free tiers. There are other chatbot prototyping tools like Chatfuel, Glitch, and QnA Maker available. The main reason for using open-source tools is that it does not need to hand over all training data to corporates like Google, Microsoft, Amazon, or Facebook. Rasa has two core parts: Rasa Core is a machine learning based framework for managing dialogues, and Rasa NLU is a natural language understanding library for the classification of intents and extraction of an entity.

2. Materials

Datasets can be created from web scraping. In this scenario, the information about a university like events, admission, placement, and other details can be scraped from the website by Python programming using packages like Scrapy or BeautifulSoup. The data can be saved as a CSV file and converted into JSON or markdown format to use in Rasa and the dataset is shown in Table 1.

Table 1. Dataset created under different classes.

Class	No. of Questions during the Initial Period	The Final No. of Questions
Events	30	68
Department	25	54
Courses	50	89
Admission	60	85
Placement	46	95
General	30	97
Total	241	488

3. Methodology

There were periods when knowledge was so plentiful and progressive that we had to use all our time to connect, create, and carry out tasks using the mechanisms, or there was the diurnal period when skills were not that progressive. At a distance since actuators, numerous electric route rudiments can likewise remain secondhand. Certain individuals comprise a polymer, elastomer, and piezoelectric. The flapper is some of the actuators, by unchanging electro-energetic polymers, air-filled helium balloon actuators, ground upshot transistors, relays, and electro instinctively, etc. Computer-aided learning and enthusiasm are offered via biographer. Communal broadcasting stages, which are no more astonishing subsequently, the circumstance that innovative public mass media are time-honored regularly and new-fangled connectivity preferences through the societal webs transpire. Numerous works in multi-operator frameworks concentrated on structuring heuristic methodologies for progressively complex arrangement issues where it is hard to determine equilibrium techniques to accomplish a similar level of innovation and humankind. The social effect of innovation is an immense part of the conversation of HCI. Computers are social actors and revealed that folks tail collective rubrics once interacting

with a computer. A reply to clientele who grumbled to BMW about their discomfort with ladies says generously them instructions while they drove. This sample supports with study viewing that community sorts from the mode that workers see their PCs. Sketch on rank features system in sociology; there is an exact gear making these insights in human-computer interactions. Readings taking place sets of beings latch that folks have diverse act outlooks for male and female folk. This analysis also devises set up that folks degree the similar act of females inferior to men on sexual category unbiased jobs.

The upcoming study might explore the option of carrying laid-back manifold methods which will show to be a useful version of picturing means of the latest devices and will come out as an innovation like a flying car. A device that is at present under process but can emerge as a benchmark in human–technology interaction as humans can interact through computers and inbuilt software embedded in these devices. Study relations between nourishment and expressive happiness founded on the skills reported in social media. In our time, plentiful almost humanoid conduct can be exposed after their virtual smidgens in communal mass media. Persons define their survival, private proceedings, their responses to products, and worldwide actions, and disclose their consumption partialities. The study suggests that having a good standard of living, counting consumption diet, can inflate private welfare and sort a being better off. This scheme will examine the affairs amid diet and emotive happiness as sensed from communal mass media. It will wish to grow better-grained designs of kindred amid the foodstuffs we consume and the feelings we know how. Expedite conception methods to discover big data and provide a rational method to assess info conception gears. The sum of facts caused in logical lessons like in being arts and ubiquitous healthcare tenders is emergent to a range that it will be stint intense, if not utterly impossible, to rub in guide scrutiny unaided to shoot notable corollaries and to confirm philosophies. To bang this aberrant, many analyses body to bring info beginning gears near assistance experts to discover the facts.

3.1. Proposed Model

This research applies the development of the Rasa model to create a chatbot. The system is divided into two main parts: teaching bot to understand user inputs using Rasa NLU, and teaching bot to respond using Rasa Core. First, the system design starts by teaching a bot to understand the user's message. For this purpose, the NLU model is trained to extract structured data from plain text. This structured data defines the intent of the message. Hence the NLU example file has two parts. Intent defines the intents related to the domain and entities which define the entities that the bot should extract from the message. The details of this file are saved as an md file. The NLU model configuration determines whether the input should be parsed to extract the feature from the text input. For this model, a predefined spacy sklearn pipeline is used. The Sklearn intent classifier trains the linear SVM that optimizes the grid search. A few ways of how a user can interpret the same are also given inside the system and shown in Figure 1. In addition, it provides the ranking of the label and selects the label with the highest rank. For entity classification, it uses the ner_crf pipeline that uses a conditional random field model. It is good for training custom entities and the file is saved as a yml file. Now an NLU model is created by rasa_nlu.train processing tool using the nlu example file and the configuration file. The model is saved in a directory. Write stories is the stage where the bot is trained to respond using the dialogue management module of Rasa Core.

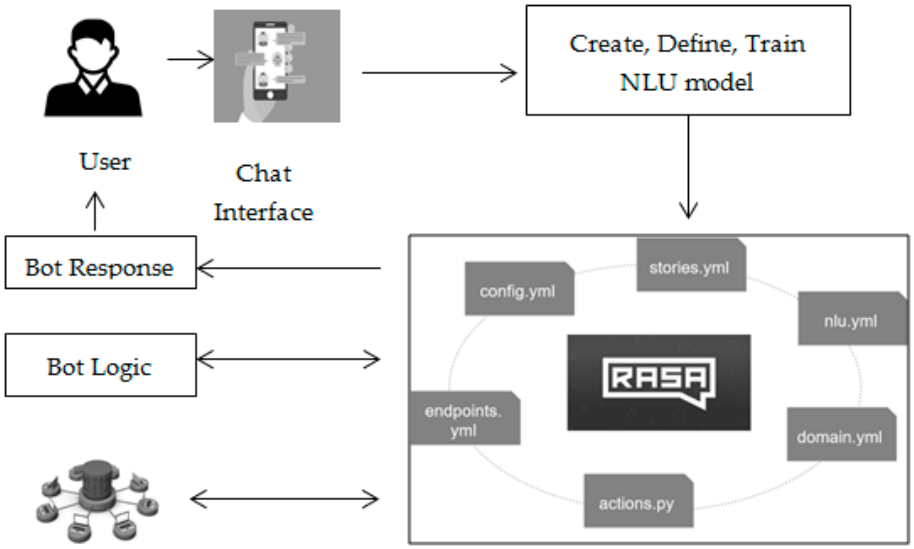

Figure 1. The proposed chatbot methodology.

The Chatbot NLU text and voice interaction pseudocode:

```
def chatbot_NLU_text_and_voice_interaction():
    # Check if the user wants to use text or voice interaction.
    if user_wants_text_interaction():
      # Start a text conversation with the user.
      user_input = input("What would you like to talk about?")
      response = chatbot_nlu_text(user_input)
      print(response)
    elif user_wants_voice_interaction():
      # Start a voice conversation with the user.
      user_input = input("What would you like to talk about?")
      response = chatbot_nlu_voice(user_input)
      print(response)
    else:
      # Ask the user to choose between text and voice interaction.
      print("Would you like to use text or voice interaction?")
```

The Rasa Core model learns to converse using real conversation data as training stories. The story is a real conversation between the user and bot where intents are expressed as user inputs and bot responses are expressed as actions. In the file, the story name starts with #, intents start with *, and the actions by -. The actions are bot utterances or a call for API and the file is saved as an md file. The domain defines the universe where the bot lives like the expected input. The actions predict and respond to the information. Also, the file is stored as an yml file. The policies decide how the dialogue model should be trained. The policies used in this model include a memorization policy that memorizes conversation or saves history.

The Keras policy uses a neural network based on LSTM and the file is saved as a yml file. The policies are customizable the model here performs better with epochs 200 and max_history of three. The dialogue model is created by the rasa_core.train tool using domain story and policy file also it is saved in a directory. After the models are ready, the bot is ready to interact. The bot starts using rasa_core.run tools that use both the nlu model and dialogue model. It also uses an endpoint to define the local host address. The API is enabled so that it is integrated with the web interface running on the same host address as mentioned before.

3.2. The Proposed Algorithm

The algorithm used to train the neural network model is called LSTM (Long Short Termshort-term Memory). LSTM is a type of Recurrent Neural Network. RNN is a multiple copy of the same node that passes the information to its successor. LSTM is designed so that the information can be remembered for a long period. Unlike other RNNs, it uses one gate whereas LSTM uses four gates. The graphical representation of the LSTM cell is shown in Figure 2.

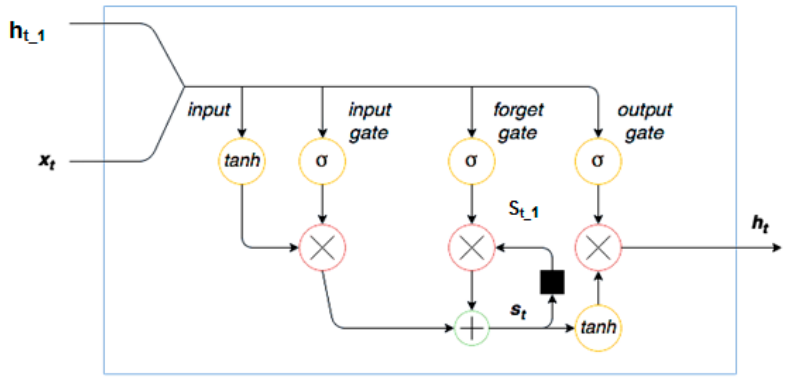

Figure 2. The architecture of LSTM Cell.

On the left-hand side, the LSTM cell takes input from the previous output s_{t_1} that is concatenated with the new word sequence $\boldsymbol{x_t}$. The first gate gets the input s_{t_1} and $\boldsymbol{x_t}$ and squashes it via ***tanh*** function. The input is squashed between "**1**" and "**−1**".

$$g = \tan h(b^g + x_t U^g + h_{t-1} V^g) \quad (1)$$

Here $\boldsymbol{U^g}$ is the weight for input and $\boldsymbol{V^g}$ is previous cell output, $\boldsymbol{b^g}$ is the input bias. The second gate takes the squashed input and passes it through sigmoidal-activated nodes. These input gate sigmoid acts to kill off any element that is not required and update the old cell with new information. The output of the second layer is,

$$i = \sigma(b^i + x_t U^i + h_{t-1} V^i) \quad (2)$$

The squashed output of the first and second gates is multiplied elementwise. The output of the input section in LSTM is expressed as,

$$g \circ I \quad (3)$$

where ∘ represent the element-wise multiplication. In the third gate, the LSTM cell has an internal state variable $\boldsymbol{s_t}$. This variable lagged one step i.e., s_{t_1} is added to the output of the second gate which creates an effective layer of recurrence. Here the addition operation instead of multiplication reduces the risk of vanishing gradients. This gate is called forget gate which gets rid of the information that is not required. The forget gate is represented as,

$$f = \sigma(b^f + x_t U^f + h_{t-1} V^f) \quad (4)$$

The output of the element-wise product of the previous state and the forget gate is represented as,

$$s_t = s_{t-1} \circ f + g \circ I \quad (5)$$

Finally, the output gate is squasheda a with ***tanh*** function that determines the value that is allowed as output from the cell as $\boldsymbol{h_t}$. The output gate is represented as,

$$o = \sigma(b^o + x_t U^o + h_{t-1} V^o) \quad (6)$$

So the final output after squashing with ***tanh*** function is,

$$h_t = \tan h(s_t) \circ o \quad (7)$$

3.3. High-Level Architecture of Chatbot

Rasa offers a lot of customization options, letting programmers create unique actions and reactions. Due to their adaptability, chatbots may be built for a variety of use cases, even ones involving intricate procedures. Because of its adaptability, customizability, robust NLU, dialogue management, community support, and affordability, Rasa is selected as an open-source chatbot creation platform. It is a flexible option for a variety of chatbot applications since it enables developers to construct chatbots that are suited to particular demands and guarantees the management of information and security. Figure 3 shows the process of the input message and the response of RASA.

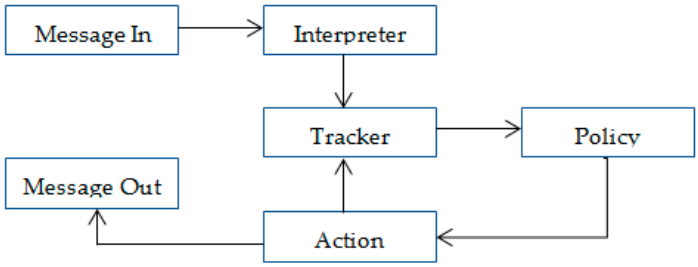

Figure 3. High-level architecture of Chatbot.

The following are the steps involved in the design process. The message gets through the interface and is passed to the interpreter for parsing. This parsed message is in the form of a dictionary. The dictionary contains intents, the entity of the message, and the original text.

1. The Tracker tracks every conversation in the communication state. It gets information whenever a new message comes.
2. The policy gets informed about the current state of a tracker.
3. The policy decides the next action.
4. All the action is logged inside the tracker.
5. A response is received by the user.

A chatbot with dynamic intelligence may engage with users via text, speech, or even visual inputs such as images or videos. It is adaptable and user-friendly since it customizes its answers to the selected mode. Dynamic chatbots can produce more imaginative and educational material. They may learn from a greater variety of sources and tailor their material to the user's interests.

4. Results and Discussions

The advantage of a machine learning-based dialogue model is that, when the chatbot doesn't know how to do something, then it can be trained. This is a powerful way to explore what the bot can do, and the easiest way to fix any mistakes that it makes. The bot is started in an interactive learning mode by the rasa_core.train tool using the nlu, dialogue model, and endpoints file. In interactive mode, the bot will confirm every prediction made by NLU before proceeding. If there is a wrong action printed, the user gets a prompt asking for the correct one. This new action log can be saved in the stories file. It is recommended to run in an interactive mode during the initial stage before deployment so that the developer can debug the wrong output, improve the bot prediction, and save it in the story file. Humanoid lives in use recycled then remain static expanding a wide array of gesticulations to lead into all further. Humanoid gesticulation stays in a mode for no spoken messages usual and tin can propose the maximum impulsive, unique than even mode towards joining up by PCs. Automating the process of gathering data from web pages is called web scraping. The

ability of chatbots to retrieve recent data from university websites is greatly improved by web scraping. Sample user interactions and responses are shown in Figure 4.

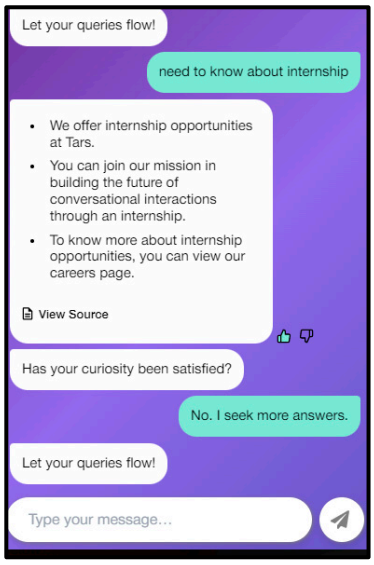

Figure 4. Sample user interactions and responses.

The developed chatbots employed web scraping to retrieve information dynamically rather than depending on static datasets or manual data entering. The top predictions in each category are shown in Table 2. The proposed technique is helping to achieve high precision in sentence analysis. The similarity computation has a high hit rate. As a result, the system can identify many approaches to posing the same query and map them to similar responses, enabling it to handle a wider range of queries.

Table 2. Comparative analysis of chatbot features with similarity feature evaluation.

Performance	Events	Department	Courses	Admission	Placement	General
Hits	156	167	132	187	190	245
Errors	8	7	12	10	10	11
Ratio	0.90	0.92	0.83	0.90	0.90	0.91

5. Conclusions

This paper discussed the development of a chatbot using an open-source platform Rasa. The advantage of using an open source is data security that nobody shares the data with corporates in their cloud while launching the application. Rasa has customizable features, and it uses the neural network to predict the response. The university website is too big and always it is supposed to be updated in real time. However, adding the data to Rasa made the task easy to create the interactive chatbot model. Lack of information can deter prospective applicants and the target market for higher education is primarily on mobile. Hence chatbots help to secure several applicants for admission and enhance the overall campus experience. Towards the conclusion of the artifact, human–computer interaction remains unique amongst emergent areas in this generation. After an overview of this human–technology interaction and the way it has evolved over generations the technologies that have come up are good for the innovations that are present but the challenges and disadvantages of this kind of interaction should be kept in vision.

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administration, T.J.J.; funding acquisition, K.R., T.J.J., M.S. and D.J.D. All authors have read and agreed to the published version of the manuscript.

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