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Smart Chatbot to Assist Users of Employment Websites in Job Search, Skill Development, and Networking Opportunities

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Abstract: This paper presents the development and implementation of a smart chatbot designed to assist users of employment websites in various aspects of their job search, skill development, and networking endeavors built using bert model, spacy model and large language model. With the increasing reliance on online platforms for job hunting and career advancement, there is a growing need for intelligent tools that can streamline the process and provide personalized support to users. This article examines a chatbot that provides many functionalities to improve job search outcomes and user experience. These functionalities include personalized job recommendations, skill development suggestions, and networking opportunities tailored to the user's queries. The paper outlines the methodology used in the development of the chatbot, including the integration of natural language processing techniques and machine learning models. The paper presents findings from comprehensive evaluation, shedding light on the efficacy of the chatbot's functionalities. The implications of this research extend to both academia and industry, underscoring the potential of AI-driven chatbots to revolutionize the way individuals navigate the job market and pursue career advancement opportunities.

Keywords: BERT, Spacy, Named Entity Recognition (NER), Large Language Models, Knowledge Base, Gradio

I. INTRODUCTION

In today's digital age, job search websites have become essential resources for people looking for chances for professional growth, networking, and employment. Numerous job ads, tools for improving skills, and channels for interacting with peers and possible employers are all provided by these sites. But for certain users, especially those who encounter obstacles like information overload, inadequate personalisation, and a lack of customised advice, efficiently browsing these websites can be difficult. The efficiency and ease offered by current technology are frequently lacking in traditional techniques of career growth and job seeking. Consequently, in order to improve user experience and maximise employment domain outcomes, creative solutions utilising chatbot and artificial intelligence (AI) technologies like large language Models are clearly needed. One way to address various important demands and potential in the sector is to construct a smart chatbot specifically designed to help users of employment websites. A chatbot of this kind can provide users with individualised assistance and support during their job search by utilising artificial intelligence and natural language processing. This include recommending appropriate jobs based on the user's tastes and qualifications, making customised recommendations for programmes that would help them grow their skills and get trained, and helping them network with other industry professionals. Furthermore, a sophisticated chatbot can facilitate users' interactions with employment websites, guide them through the difficulties of the job search process, and eventually improve their chances of discovering options for suitable employment. The primary objectives of this research are to leverage advanced AI technologies, including the BERT model, SpaCy, and large language models, to design and develop a smart chatbot tailored to assist users of employment websites comprehensively. Harnessing the power of these cutting-edge technologies, the chatbot aims to provide personalized recommendations and assistance based on users' queries, suggesting relevant skill development resources, and facilitating networking opportunities with professionals in their respective fields.

II. LITERATURE SURVEY

The research by Dillahunt and etal [1] examined the manner in which individuals seek employment in the current digital era. They discovered that exploring job websites and other online job boards is a really beneficial way to find employment. They did, however, also find that networking—whether through friends or business contacts—remains crucial to employment prospects.

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It's fascinating to note how these tactics vary in their effectiveness for various demographic groups based on factors such as education level or age. In summary, this study provides valuable insights into the evolution of the job search process and the reasons why it is critical to assist all job seekers in the contemporary labour market.

The creation, analysis, and assessment of chatbots customised for career advancement and job search support have been thoroughly studied in the past by Koivunen and etal [2] . The purpose of these chatbots is to assist users with job listings and application procedures, comprehend user inquiries, and offer tailored recommendations. By responding to questions, making pertinent recommendations, and setting up meetings with possible employers, they provide job searchers with prompt support. Nevertheless, issues with data security and privacy still need to be addressed, as does guaranteeing the precision and dependability of chatbot responses. To fully investigate how chatbots might improve the hiring process and help users reach their career objectives, more study is required.

The development of chatbots for employment websites relies on advancements in AI technologies and NLP techniques. Devlin and etal. [3] have extensively worked on how BERT can be used for language understanding. Honnibal and et al. [4] did research on spacy for entity recognition. Zhao and etal in [5] have explored various large language models and their use cases. These technologies enable chatbots to understand user queries and provide relevant responses, facilitating effective assistance for job seekers navigating employment websites.

III. METHODOLOGY

The whole methodology is categorised into the below steps: i.e

1) Data collection: collecting different types of queries (data) from various sources and labelling them with the probable intents
2) Annotating the collected queries with entities for entity recognition.
3) Training the Bert model on labelled queries for intent classification.
4) Training the spacy model for custom-named entity recognition.
5) Having a knowledge base that has a repository of different types of jobs.
6) Having a Large Language Model for Skill Development Suggestions.
7) Integrating all of the above with a user interface where users can enter queries and get recommendations

A. Data Collection

Data was collected from various sources on the web, and textual expansion was done on those queries by changing the location and job type, resulting in an increase in the size of the data to 1339 queries. The figure in [1] demonstrates the same. All 1339 queries were labelled based on their nature and probable intent.

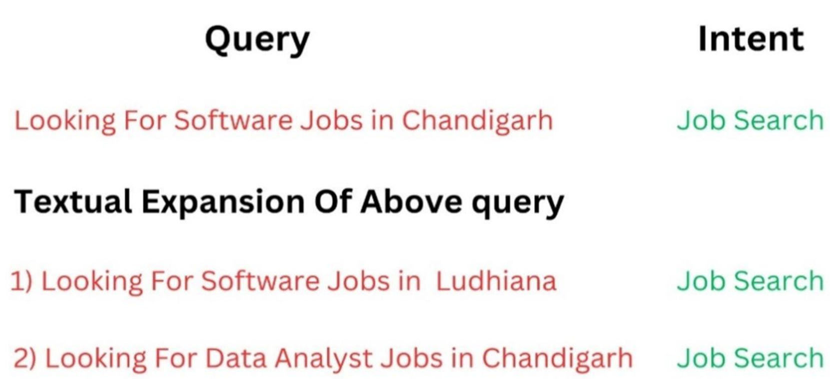

Fig 1. Textual Expansion of Query

All queries were labelled with six different intents: job search, internship search, networking opportunities, skill development, career advice, and information retrieval. The picture in **Figure 2 shows** the distribution of queries across various intents.

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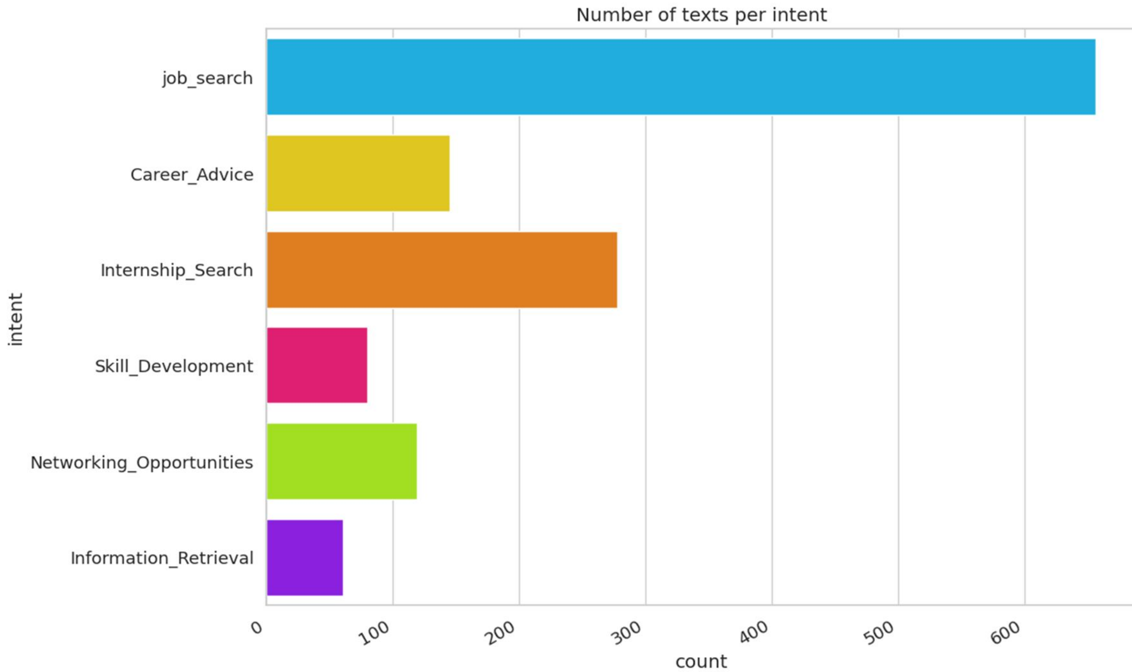

Fig 2. Bar Plot showing distribution of Queries over 6 Intents

The pre-trained BERT(Bidirectional Encoder Represenation Transformer) was fine-tuned on the above queries with the labelled intents for intent classification. Queries related to job search, internship search, and networking opportunities were annotated with probable entities as shown in figure 3.

```
("I'm looking for software job openings in Mumbai.",
{'entities': [(16, 24, 'JOBTYPE'), [41, 47, 'LOCATION']]}),

('Find me software employment opportunities in Delhi.',
{'entities': [(8, 16, 'JOBTYPE'), [45, 50, 'LOCATION']]}),
```

Fig 3. Annotation of Query for Custom NER

All the annotated data was used to train the spacy model for custom-named entity recognition; the best model was used during the whole implementation. MongoDB was used as a knowledge base, which has data on the collection of jobs. **Figure 4** shows the architecture of the whole methodology.

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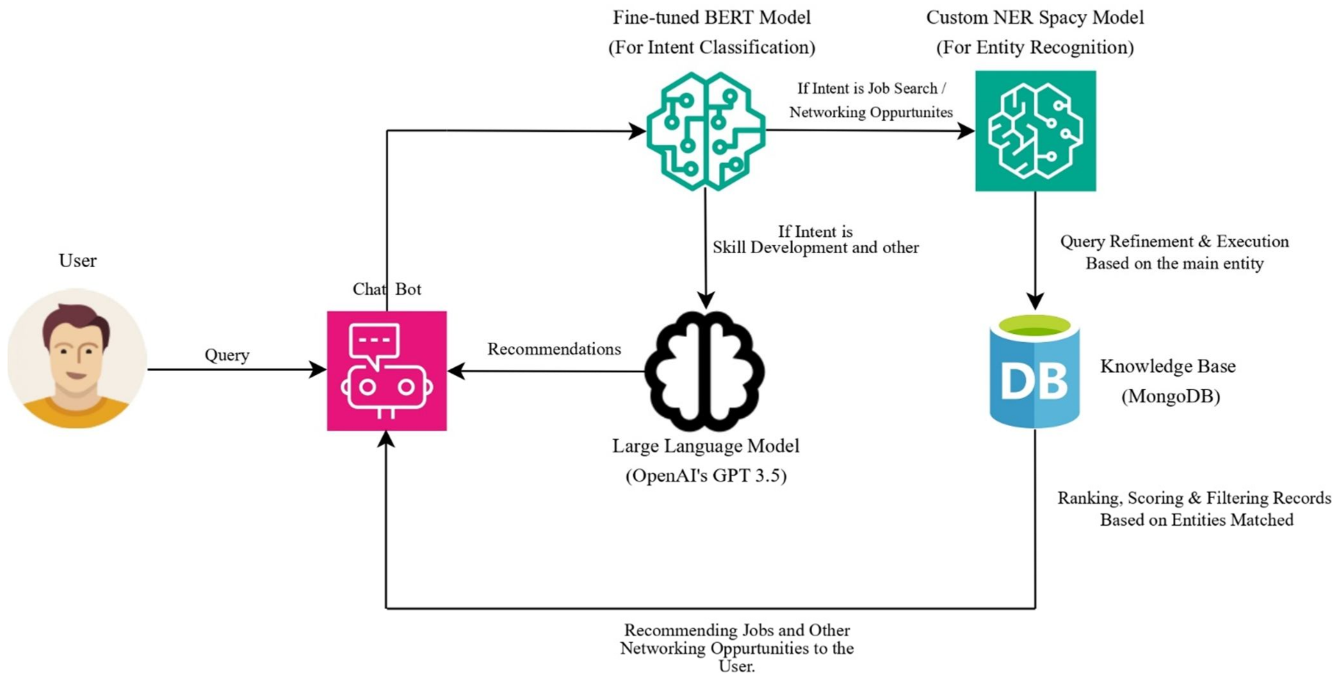

. Fig 4. Architecture of Proposed Method

Whenever a user enters a query, the query is passed on to the Bert model for intent classification.

1) If the intent is job search, internship search, or networking opportunities, the query will be passed to the spacy model for entity recognition, where entities get recognised like job type and location. The records from the knowledge base that match either partially or fully with the main entity "JobType" get retrieved. Each record is then ranked and scored using the nearest match approach based on the number of entities matched with the data in the record. The record (Job) with the highest score then gets recommended to the user in an understandable way.

Data Retrived from Knowledge Base	No of Entities Matched/Score
1) Role: Software Developer Location : Chandigarh	2
2) Role: Software Developer Location : Banglore	1
3) Role: Software Engineer Location : Ludhiana	1

Fig 5. Scoring The Retrived Jobs Based on Users Query

2) If the intent is Career Advice, skill development and information retrieval. Then The query is passed on to the large language model (OpenAI's GPT 3.5), whose response is recommended to the user.

IV. RESULTS AND DISCUSSIONS

A smart chatbot to assist users of employment websites in job search, skill development, career advice, and networking opportunities was obtained, which was built using a fine-tuned BERT model for intent recognition and a spacy model for custom-named entity recognition. The chatbot was integrated with OpenAI's GPT 3.5 for career advice and a knowledge base for recommending jobs. Gradio was used to build the interface of the chatbot.

Below are the figures for various features of the chatbot.
Figure 6 shows the user interface of the smart chatbot.

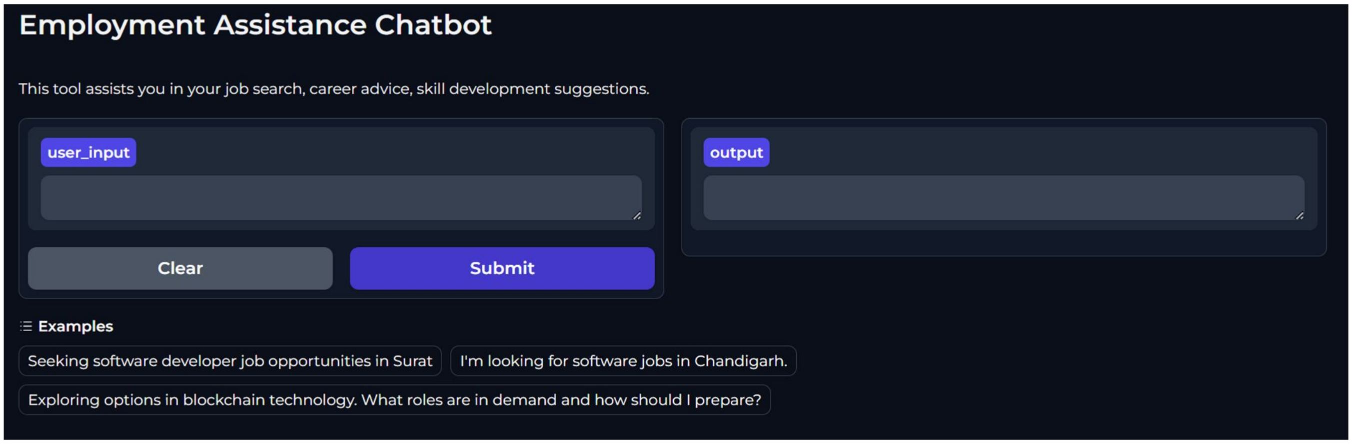

Fig 6. UI of Chatbot (Built using Gradio)

Figure 7 shows the chatbot recommending the job that matches the user's needs. The intent of which is job search.

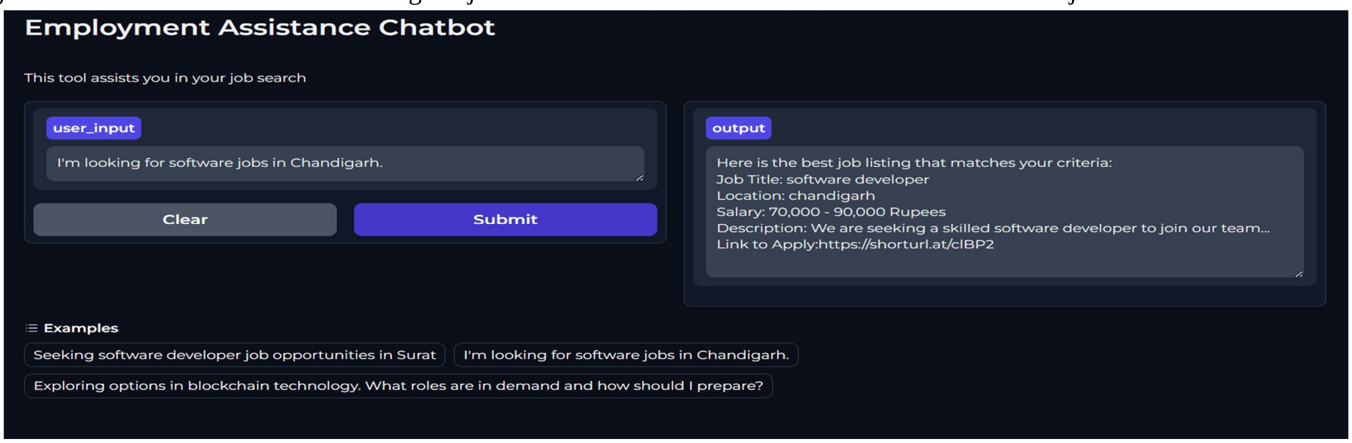

Fig 7. Chatbot Recommending the job which matches users query

Figure 8 shows the chatbot recommending an internship that matches the user's needs, where the intent of the user is an internship search.

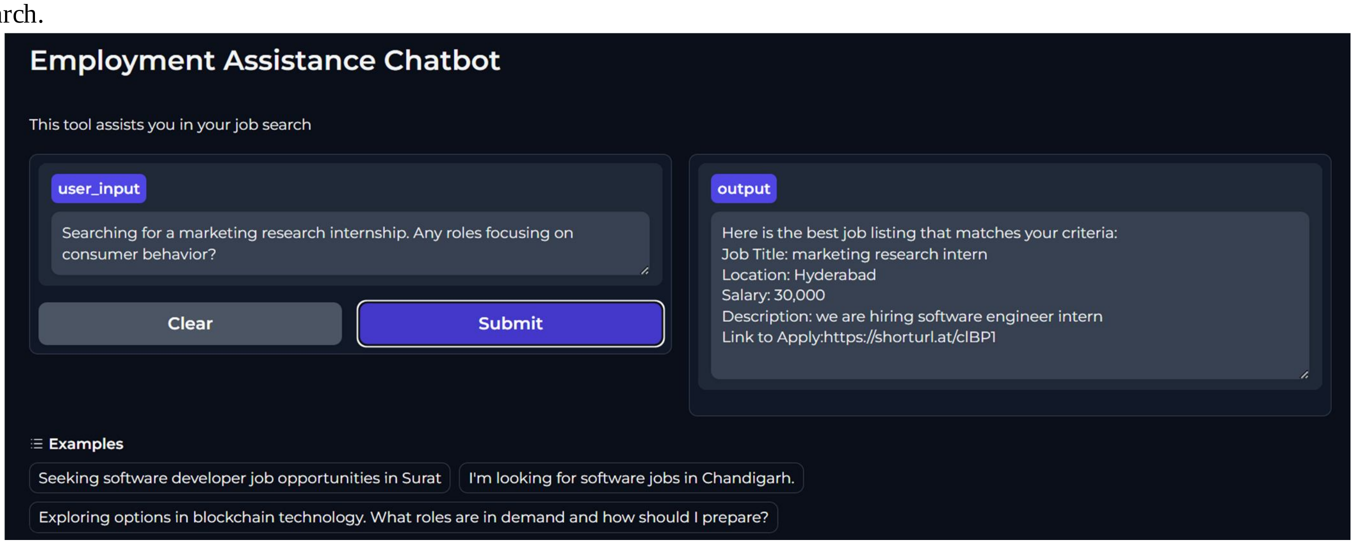

Fig 8. Chatbot Recommending Intership

Figure 9 shows the chatbot giving career advice according to the user's needs, where the intent of the user is career advice.

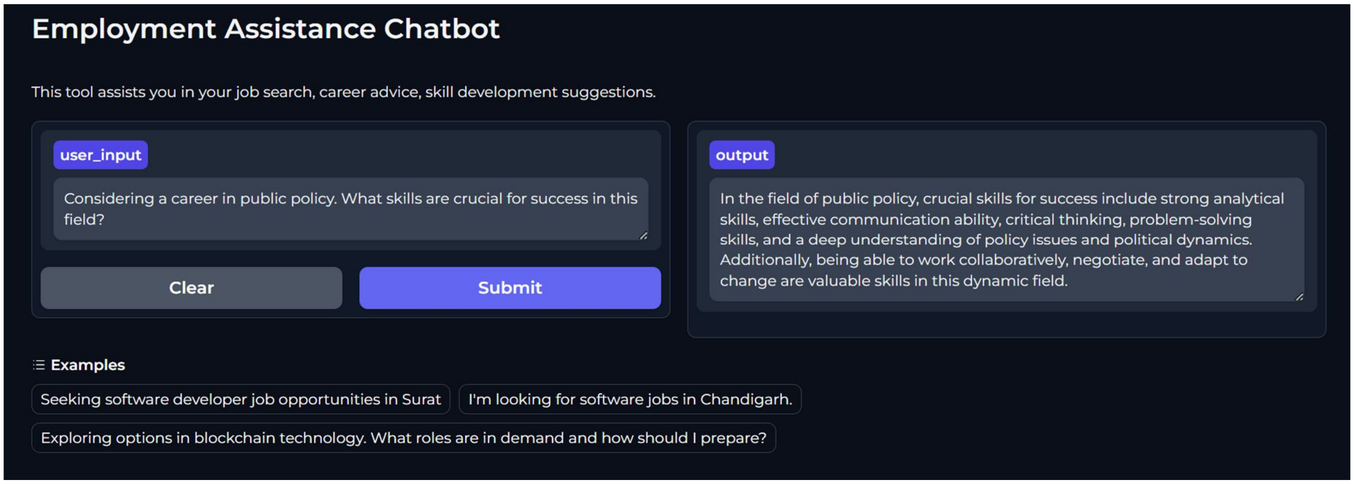

Fig 9. Chatbot Giving Career Advices

Figure 10 shows the chatbot giving skill development suggestions according to the user's needs, where the intent of the user is skill development.

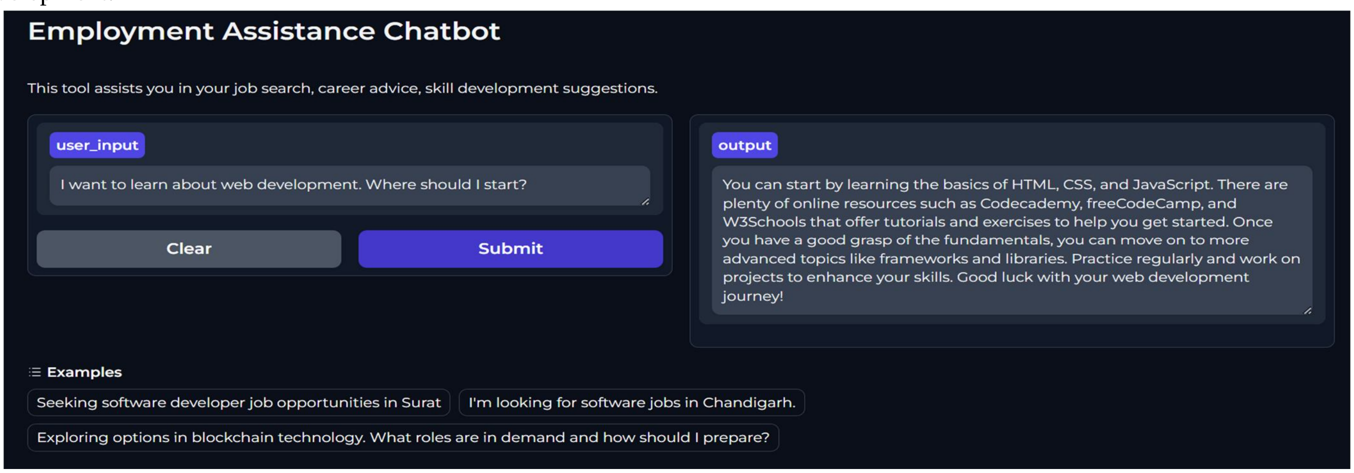

Fig 10. Chatbot Giving Skill Development Advices

Figure 11 shows the chatbot giving information according to the user's needs, where the intent of the user is information retrieval.

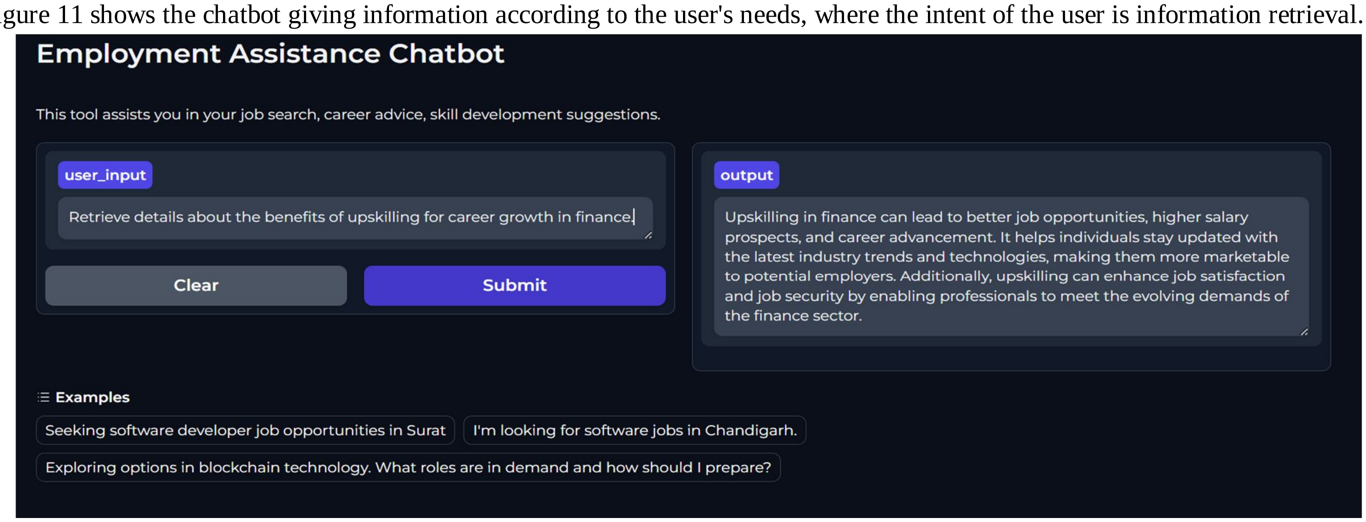

Fig 11. Chatbot Answering Information Retrieval Query

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There were five training iterations of the bert model, each round had 42 batches of samples. As the training progressed, there was a similar pattern: every time the model becomes more accurate on the training data and thus its loss decreases step by step. In the beginning, the model's loss was 1.0067 with 65.12% accuracy but they significantly changed in subsequent rounds to give accuracy of 99.93% and loss of 0.0204 as final results. On validation data, the models performance fluctuated with an accuracy range between 72.86% and 83.57%, while its loss varied from 0.4712 to 0.6391. As the size of the data was less. The model fails to generalize in few cases. Going forward the model with be able to generalize well, with more data collection and finetuning. The figure 12 shows training accuracy and loss over the course of iterations

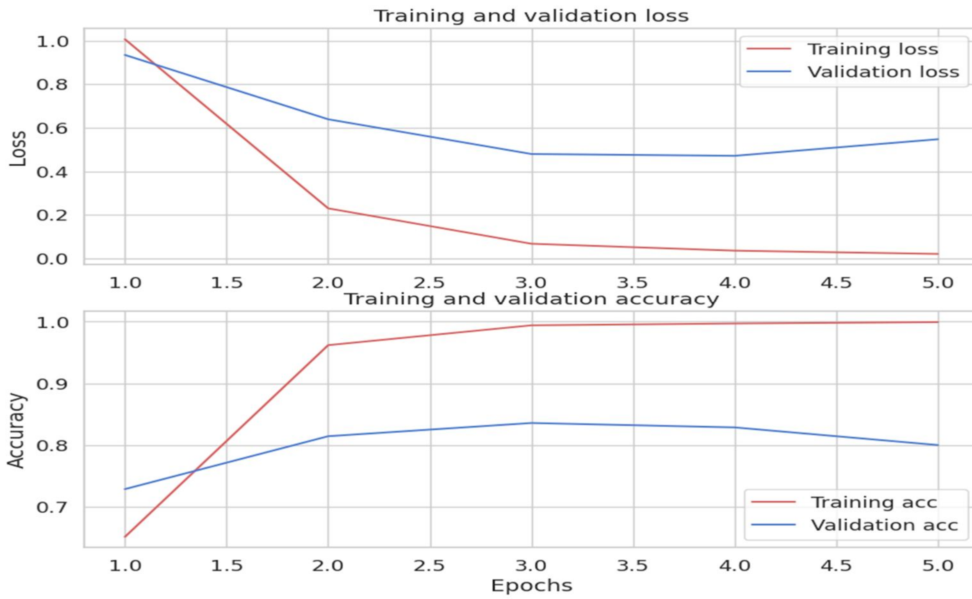

Fig 12. Loss and Accuracy Plot of Training and Validation Phase

V. CONCLUSION

This study demonstrates the potential of leveraging advanced AI technologies, including the BERT model, SpaCy, and GPT-3.5, to develop a smart chatbot aimed at assisting users of employment websites in their job search, skill development, and networking endeavors. Smart chatbots can offer personalized recommendation & guidance to job seekers at every stage of their job search journey. The findings of this research Manifest the effectiveness of chatbot in enhancing the job search experience for users. This research lays foundation for future innovations in chatbot design and implementation. Moving forward, with more data coming in the performance and the generalization ability of the models will only get better resulting in, tackling users query in a more better way.

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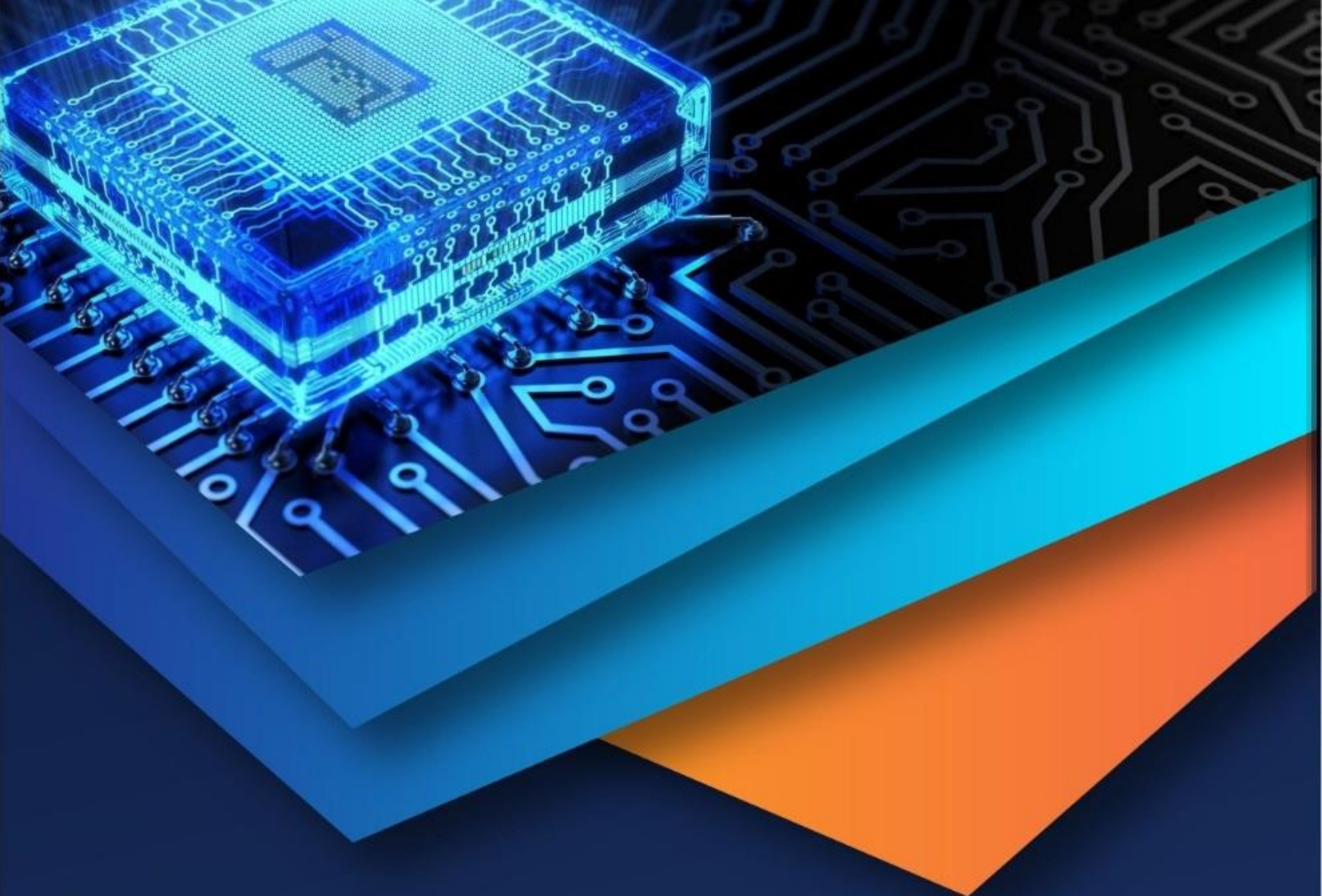

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