



Chat-Bot for FSM

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Project Background

In the support service, one of the most important aspect is quality and precise supports. Customers go through a lot of questions and problems from technological to data safety, and lack of support at any stage may prevent user/customer from using that particular technology making it a failure. Due to higher number of issues, large number of queries remain unanswered; sent through emails and call centers. This is where Machine Learning and Natural Language Processing can provide an alternative for Chat-support and user experience to support other service channels.

Challenges:

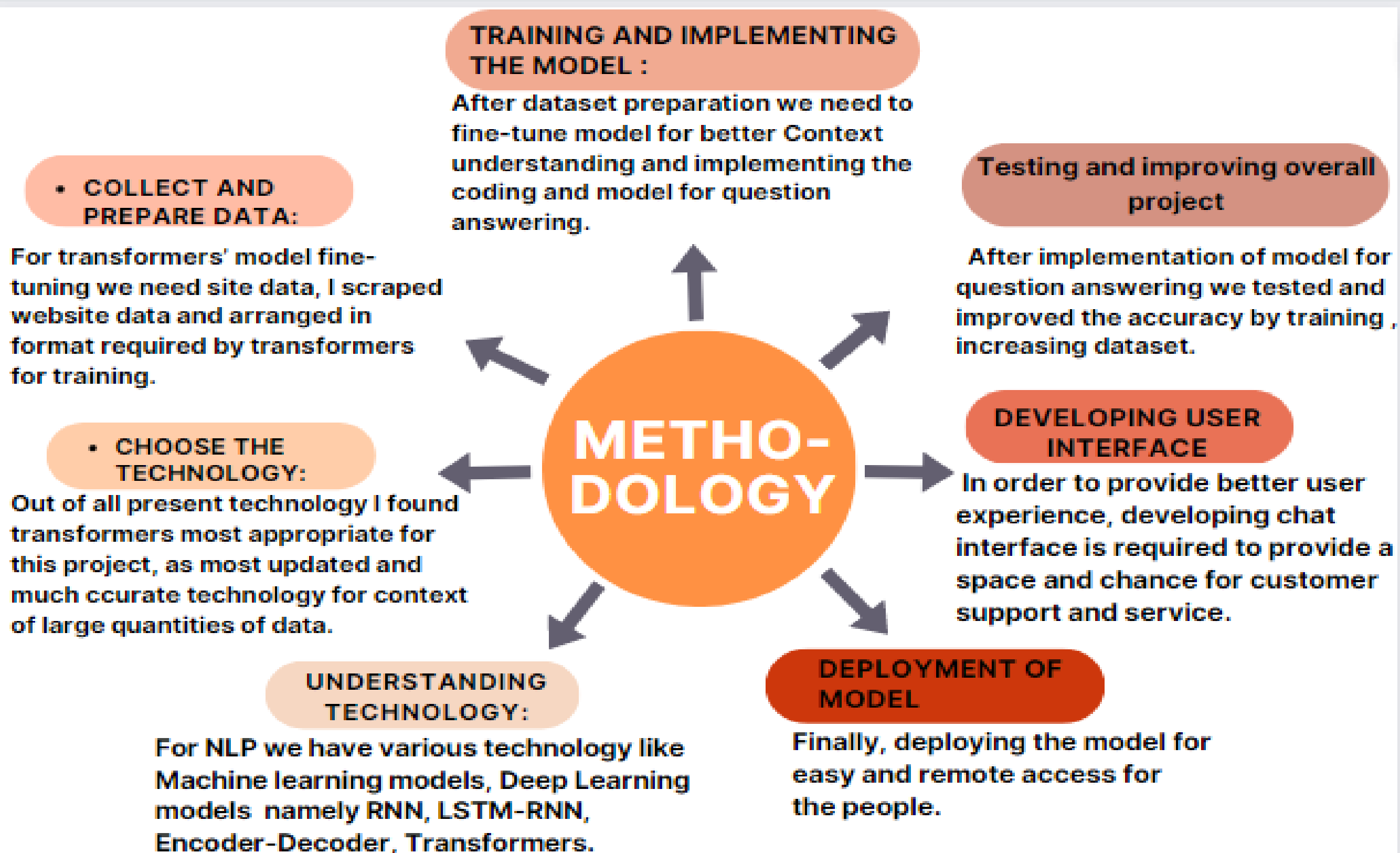
In order to achieve this we had various obstacles namely, data extraction and arranging it into squad dataset, lack of hardware resources like RAM,CUDA for processing large data, large training time.



Objective

- ☐ Main Objective is to develop a Chatbot from scratch for a FSM website.
- ☐ The Chatbot should be able to understand user queries or interactions within the context of the website.
- ☐ Not only understanding queries but also generate relevant and accurate responses in real-time.
- ☐ To provide an user interface to obtain information, support, or assistance related to the website's content and services
- ☐ Deploy the model for better reach

Methodology



Collect and prepare data:

- Web scrapping was done using beautiful soup, and heading, paragraphs were extracted.
- Some divisions As given in the fig (i) are extracted through searching div “sppb-addon-content”
- Explained how scrapping of links was done for example button named “Learn more” .

|_Dashboard (1st link)

|_ all links on dashboard (eg. Links of Technologies, services, facilities)

|_ all links on redirected Page (eg. All the links on Technologies, Services page)

- Scrapped data is in json format.

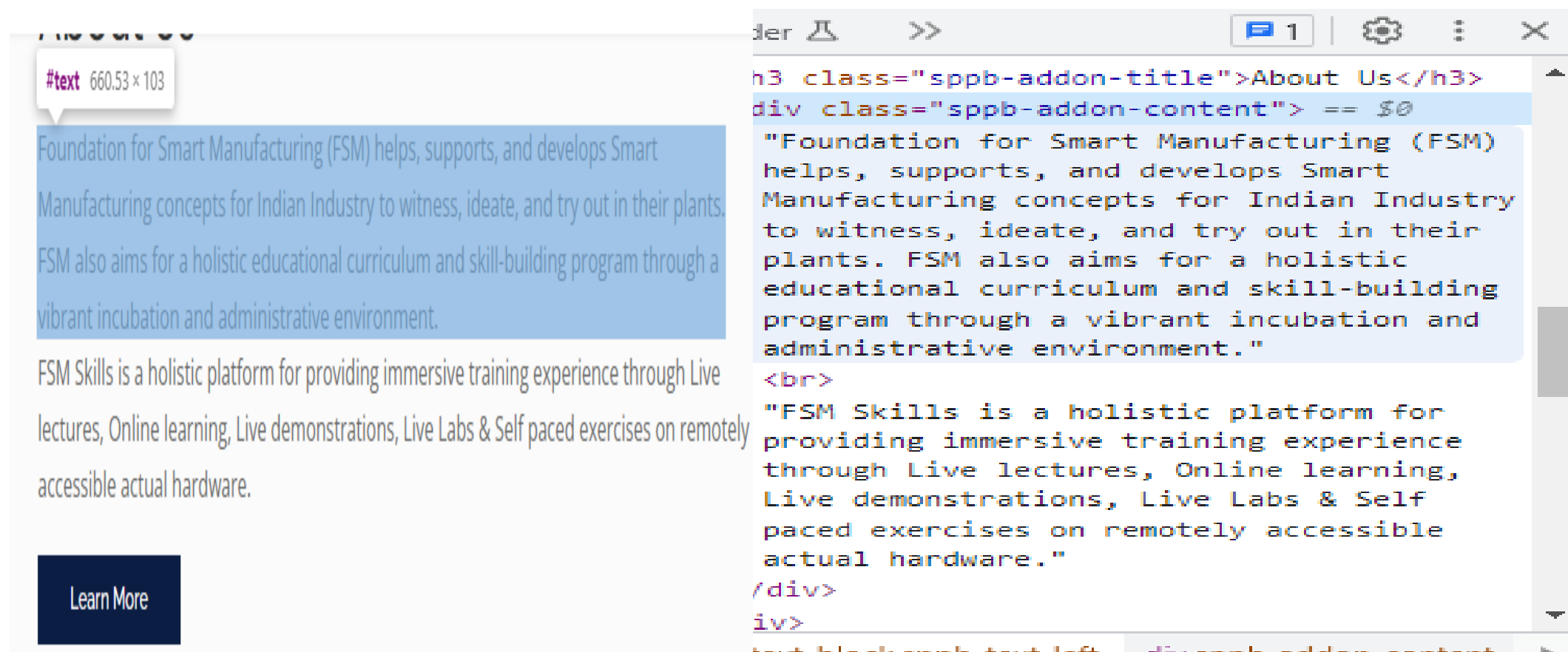
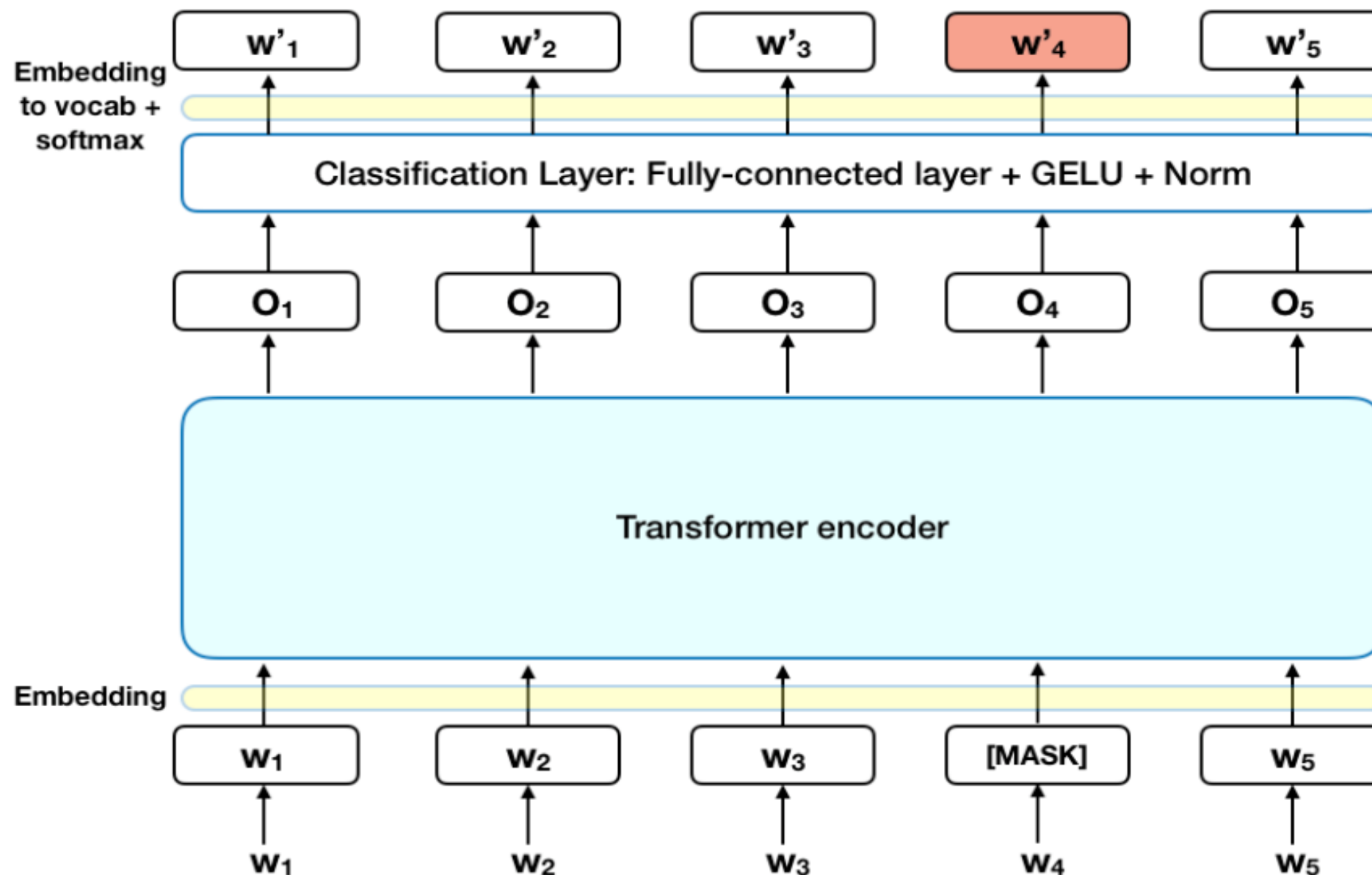


Fig (i) “About” Section of Dashboard Page (highlighted)

Implementation

• Overview of Transformer :

Transformer is used when there is large context to understand. It consist of three things namely, encoder, decoder, Neural network. In this; question, context are provided to encoder. And there is neural network in between encoder and decoder. The weights of neural network provides the information which word in context need to be addressed and, has some importance, wrt context relation. These words (vector) are then passed to decoder which convert tokenized value to actual word and previous word is used to predict current word.



- **Testing and improving overall project:**
 1. BERT model pre-trained on SQuAD is used.
 2. To increase accuracy, the model is fine-tuned on website data.
 3. Scrapped data was in json format Fig(iv), now processed the data to make it a context (removing symbols, spaces , lines).
 4. Used the above context to generate question-answer in SQuAD format using Haystack Annotation Tool for fine-tuning. Fig (v),fig(vi)
 5. Used **1.pipeline confidence score, 2.string search** (target_word, topic on which question is asked) to get exact answer.

```
final_iafsm_scrapping_json.py  final_website_data.json X  final_chatbot.ipynb  final_training_model.ipynb  linear_regression.ipynb
hello > {} final_website_data.json > [ ] p_content
1  {
2    "div_content": [
3      "At FSM we provide various Client services and training under the domain of Smart Manufacturing. The servi
4      "Education & Training",
5      "Consulting",
6      "Site Integration",
7      "Skill Certification",
8      "Prototyping",
9      "Research",
10     "",
11     "Foundation for Smart Manufacturing (FSM) helps, supports, and develops Smart Manufacturing concepts for I
12     "FSM is focussed on enabling people from becoming Smart to Samarth (capable) fraternity by creating awaren
13     "Academic strength of IIT Delhi brought interdisciplinary learnings to FSM. Expert Faculty members from va
14     "FSM has highly trained manpower to implement the Industry 4.0 projects in guidance with experienced facul
15     "M.Tech and Ph.D students doing research in Smart manufacturing are contributing to FSM technologies and i
16     "FSM brought industry partners from MNCs operating all across the globe to bring rich experience in the sm
17     "The Automation Industries Association (AIA) in its quest to set up a Common Engineering Facility Center (
18     "",
19     "Contact us today for implementing",
20     "Call us for any query011-26582053, 8076197190",
21     "or email us oninfo@iafsm.in",
```

Fig (iv)



- what are services of Mobile Collaborative Robot? 1
- what is Mobile Collaborative Robot? 1
- what are the features of CPF? 3
- what is CPF? 4

The Mobile Collaborative Robot (MCR) is developed to achieve autonomous material transportation within the Cyber Physical Factory. The MCR consists of a TM5M700 collaborative robot mounted on top of an Addverb Automated Mobile Robot (AMR). The AMR uses a LIDAR and two depth cameras to navigate using Natural Navigation. It has a payload of 150 kg. The AMR runs on Robot Operating System (ROS). The collaborative robot mounted on top of the AMR has a camera on it. The cobot can be programmed using ROS or the TMFlow software. The feed from the camera can be used for object detection. The cobot has a payload of 6 Kg. The MCR can also be controlled using a Fleet Management System. The MCR can be dispatched to various locations in the map using REST Api communication through the Fleet Management System.

Services Education & Training Device Services

Cyber physical factory (CPF) is also known as Discrete Micro Production Facility or simply Micro Production Facility. It demonstrates the convergence of the Informational Technology (IT) and Operational Technology (OT) at micro factory level where the machines are discretely located. It has 18 varieties of machines for different manufacturing operations.

The key features that this factory has: Customer Order Management Production Order Management Material Management

Fig (v)

```
hello > {} more_answers_squad_data.json > [ ] data > {} 2
1  {
2    "data": [
3      {
4        "paragraphs": [
5          {
6            "qas": [
7              {
8                "question": "explain Remote Maintenance?",
9                "id": 1064369,
10               "answers": [
11                 {
12                   "answer_id": 951969,
13                   "document_id": 1582518,
14                   "question_id": 1064369,
15                   "text": "Being able to assist customers remotely, serv
16                   "answer_start": 0,
17                   "answer_end": 779,
18                   "answer_category": null
19                 }
20               ],
21               "is_impossible": false
22             }

```

Fig (vi)



Implementation

- **Developing User Interface:**

For user interface I used Gradio as time was less , and I found it easy to implement where first, question answering interface was used. Then I got introduced to State parameter which used to keep all the asked question on screen like chats on WhatsApp if not refreshed. While, I was trying with state parameter I got to know about Chat Interface of Gradio. Now, this Chat Interface was used where I was getting errors of list and string. However, resolved them using print and type function.

Deployment of model (project):

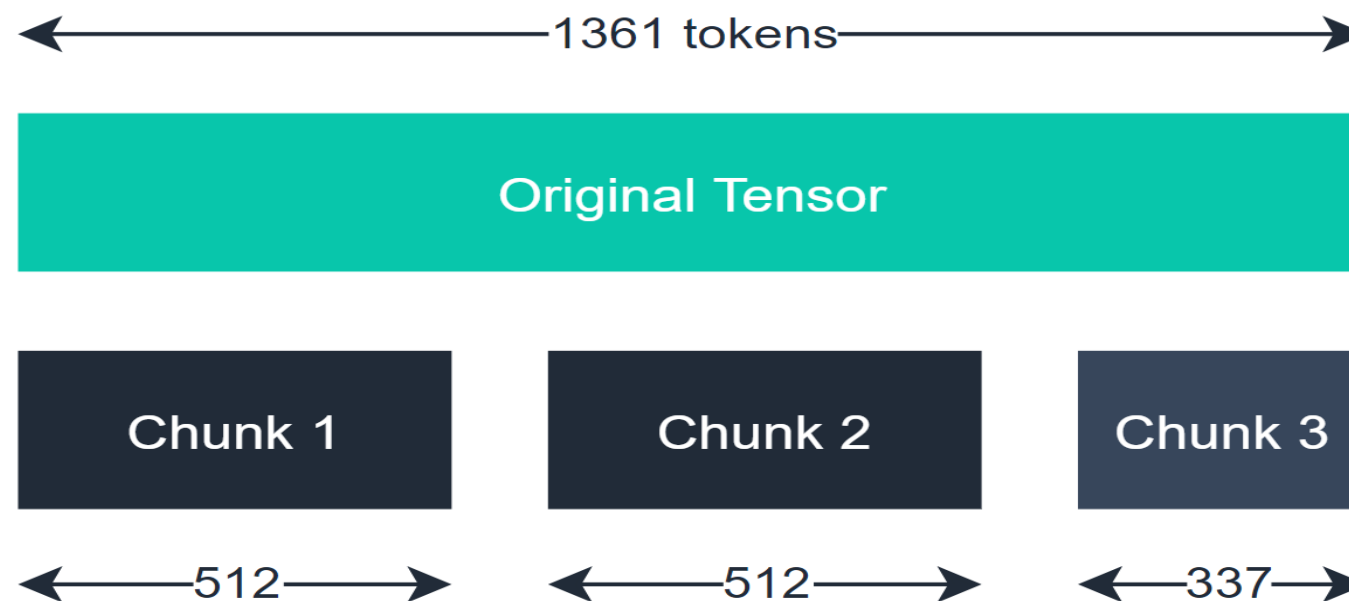
Finally, deploying the model for easy and remote access for the people.I used Hugging-face spaces .

Here is the link for deployed model:

<https://huggingface.co/spaces/Nickitaa/gradio-chatbot>

Innovation in Implementation

1. BERT model can only reads 512 tokens (including two special tokens) at a time and truncate rest of the context. Divided context of 15K+ words in BERT model into chunks each of 512. However last chunk can have less than 512 tokens



2. After fine-tuning and training the model, bot was giving answers but there were some extra stuff. So in order to solve this I used two things:

1. Confidence score 2. String search

- I used a pipeline confidence score to search for answer that has correct context with respect to question i.e. answer with high score.
- For, string search I extracted out target_word from question; line having these word are part of the exact final answer.



Outcome

After developing the graphic user interface of chat-bot system. Question is been typed in the prescribed area and answers related to that are generated. This, bot can answer questions related to site.

I tested my code against three different size of context

1. 512 tokens
2. 3 chunks each of 512 size
3. 28 chunks each of 512 size (complete site data)

Following is the output:

(output presented is using complete site data)

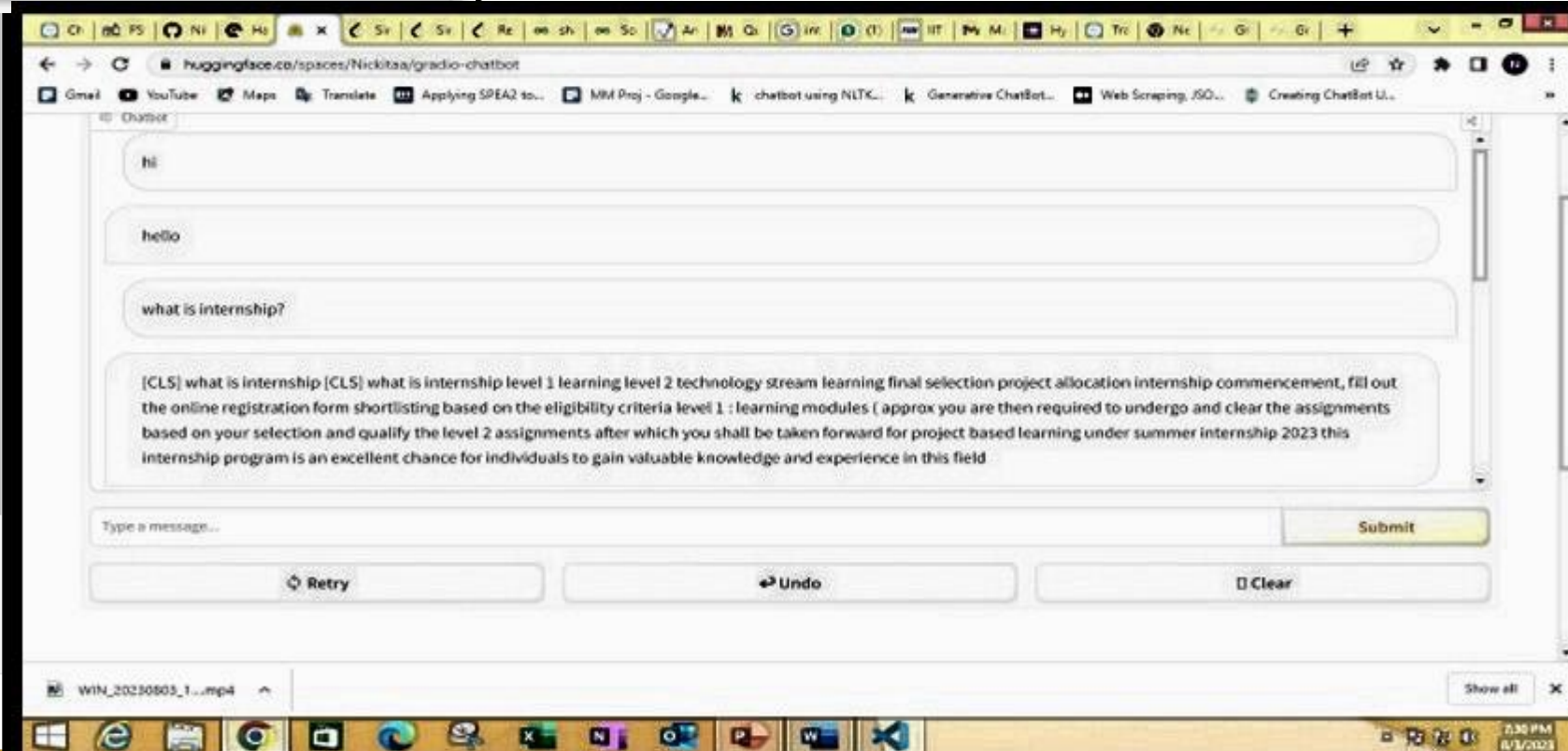
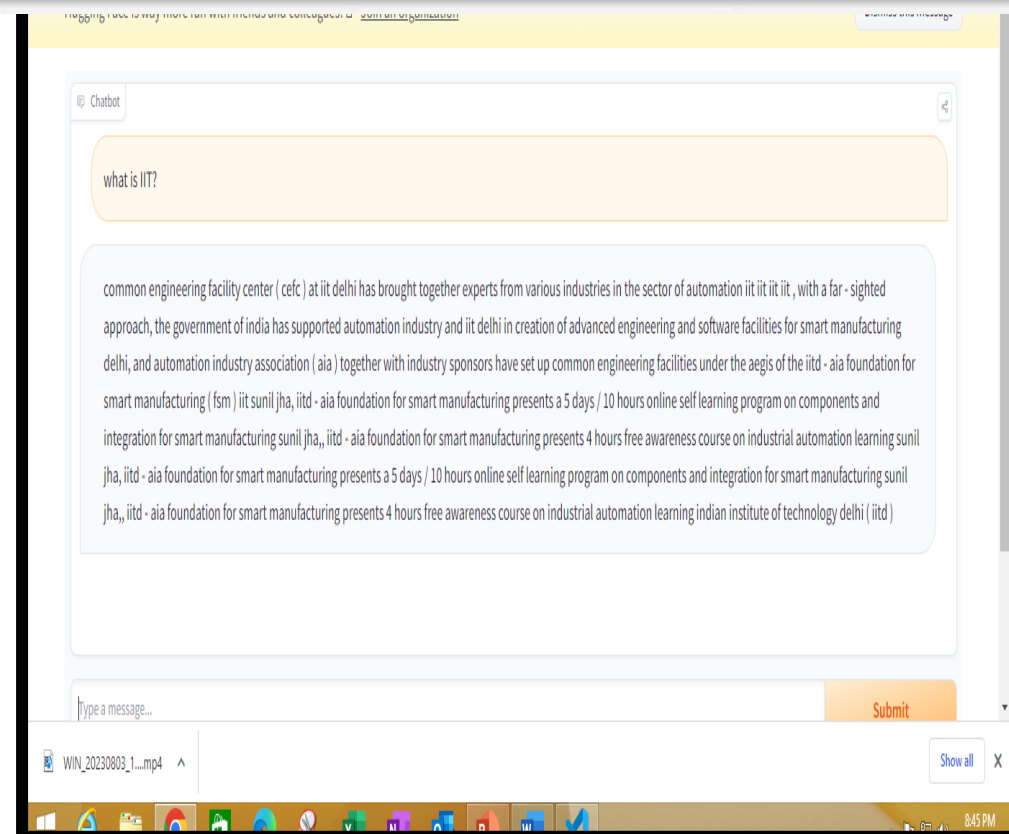
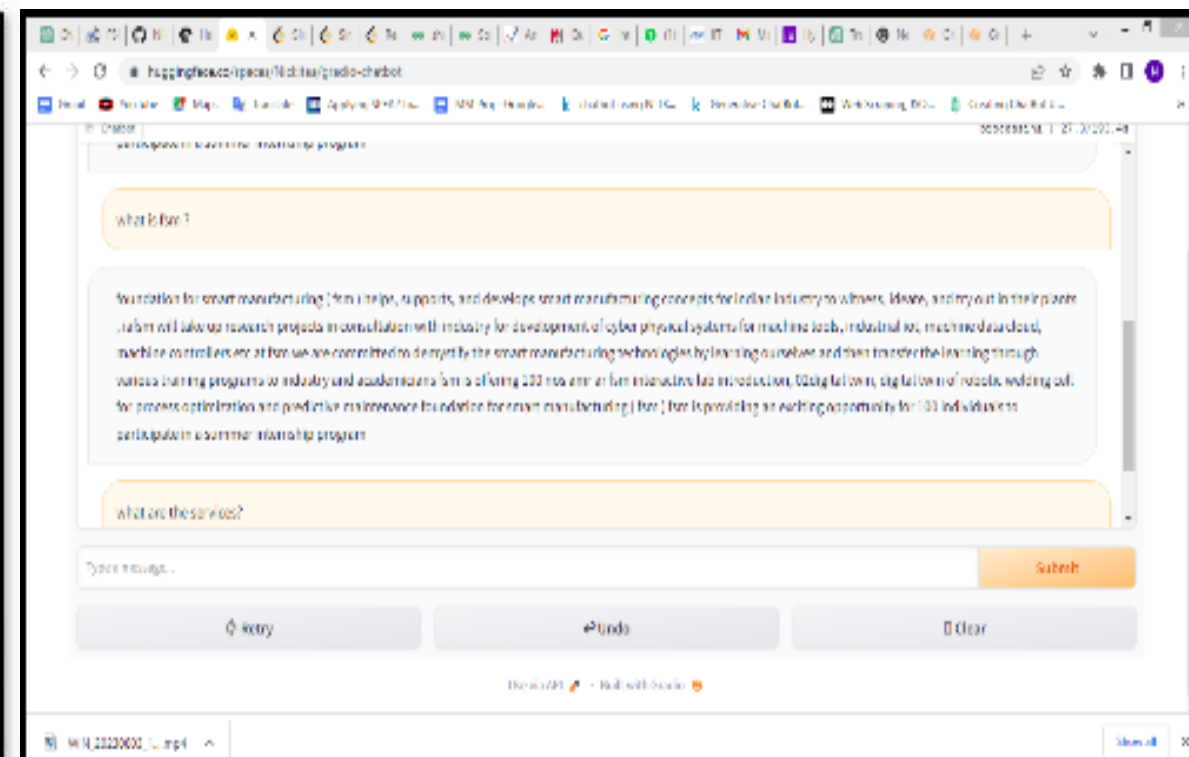
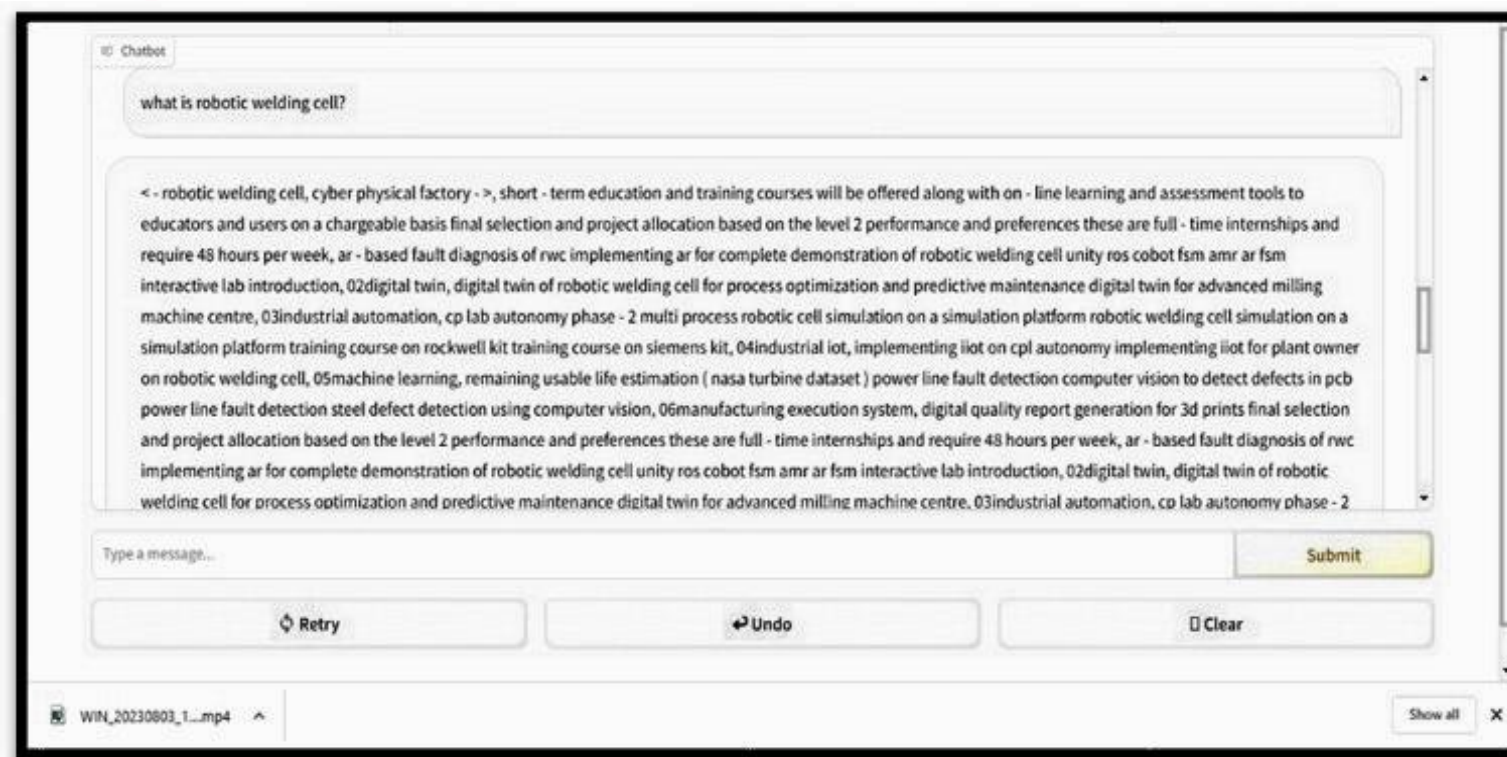
The screenshot shows a chatbot interface with a title bar 'Chatbot'. The chat history includes:

- Question: "what is FSM?"
- Answer: "foundation for smart manufacturing (fsm) helps, supports, and develops smart manufacturing concepts for indian industry to witness, ideate, and try out in their plants what is fsm these were designed, manufactured and integrated in fsm foundation for smart manufacturing (fsm) , an ar application designed to run on hololens 2 to demonstrate the entire sequence for motor replacement in the fsm smart mechanism kit foundation for smart manufacturing (fsm) , and it helps supports and develops technologies for right understanding and implementation of concepts of smart manufacturing"
- Question: "what is collaborative robots?"
- Answer: "as collaborative robots operate without physical safeguards, they have to permanently calculate the risk of colliding with humans, constantly checking this via the robot controller"

At the bottom, there is a text input field labeled "Type a message..." and a yellow "Submit" button. Below the input field are three buttons: "Retry" (with a circular arrow icon), "Undo" (with a left arrow icon), and "Clear" (with a square icon).



Results





Scalability

In the fourth industrial revolution, Smart and Samarth technologies are evolving and NLP will provide a hand for development.

- In transformer model one of the important step for behavior of model towards prediction is fine tuning, model can be fine-tuned with customized data to suit specific requirements of industry and it can be domain specific and more relevant to industry.
- Transformers model pre-trained in various international language are available in the industry. So, it can be deployed round the globe and international collaboration will be easy.
- It can be relevant in assistance and support service, which the model is doing now i.e., aiding the user queries but it can provide assistance to developers in particular domain with respect to data provided.
- If provided with resources like cloud, better processing units it can handle and can be accessible to wider audience with less execution time



Thank You

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