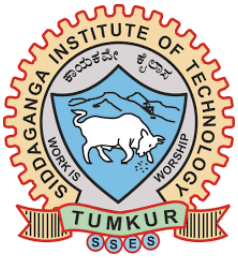
SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-572103

(An Autonomous Institute under Visvesvaraya Technological University, Belagavi)



A Miniproject Report on

"QPGen:Artificial Intelligence-Powered Question Paper Generator for Educational Organization."

submitted in partial fulfillment of the requirement for the completion of V semester of

BACHELOR OF ENGINEERING

in

INFORMATION SCIENCE & ENGINEERING

Submitted by

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DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

2024-25

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-572103

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DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

CERTIFICATE

Certified that the miniproject work entitled "QPGen:Artificial Intelligence-Powered Question Paper Generator for Educational Organization." is a bonafide work carried out by Keerthan S G (1SI22IS041), Madan M(1SI22IS048), Vignesh H P(1SI22IS123) and Meghana V (1SI22IS125) in partial fulfillment for the completion of V Semester of Bachelor of Engineering in Information Science and Engineering from Siddaganga Institute of Technology, an autonomous institute under Visvesvaraya Technological University, Belagavi during the academic year 2024-25. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the department library. The project report has been approved as it satisfies the academic requirements in respect of mini project work prescribed for the completion of the V semester Bachelor of Engineering degree.

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Course Outcomes

After successful completion of mini project, graduates will be able to

CO1: To identify a problem through literature survey and knowledge of contemporary engineering technology.

CO2: To consolidate the literature search to identify issues/gaps and formulate the engineering problem

CO3: To prepare project schedule for the identified design methodology and engage in budget analysis, and share responsibility for every member in the team

CO4: To provide sustainable engineering solution considering health, safety, legal, cultural issues and also demonstrate concern for environment

CO5: To identify and apply the mathematical concepts, science concepts, engineering and management concepts necessary to implement the identified engineering problem

CO6: To select the engineering tools/components required to implement the proposed solution for the identified engineering problem

CO7: To analyze, design, and implement optimal design solution, interpret results of experiments and draw valid conclusion

CO8: To demonstrate effective written communication through the project report, the one-page poster presentation, and preparation of the video about the project and the four page IEEE/Springer/ paper format of the work

CO9: To engage in effective oral communication through power point presentation and demonstration of the project work.

CO10:To demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics.

CO11: To perform in the team, contribute to the team and mentor/lead the team

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO-1	3											3	3	
CO-2		3										3	3	
CO-3			3					2		3				
CO-4						3								
CO-5	3	3												
CO-6					3						3			
CO-7		3	3	3										
CO-8														
CO-9									3					
CO-10								3						
CO-11									3		3			
Average	3	3	3	3	3	3	3	3	3	3	3	3	3	

PSO mapping to be done by respective Dept.

Attainment level: - 1: Slight (low), 2: Moderate (medium), 3: Substantial (high)

POs:

PO1:Engineering knowledge, PO2:Problem analysis, PO3:Design/development of solutions, PO4:Conduct investigations of complex problems, PO5:Engineering tool usage, PO6:Engineer and world, PO7:Ethics, PO8:Individual and collaborative work, PO9:Communication, PO10:Project management and finance, PO11:Life-long learning.

PSOs:

PSO1:Computing system, PSO2:Communication and Security, PSO3:Information management

Abstract

Designing question papers for exams is a highly time-consuming process of balancing subject matter, difficulty level, question types, and modules. Traditional approaches are inefficient, inconsistent, and not adaptable, making it difficult for an educator to maintain the diversity in academic requirements alongside the institutional objective. This calls for an automated and intelligent solution towards streamlining the entire process of exams without compromising the quality and equity of assessments.QPGen, an AI-powered system, meets this need by automating the generation of customisable question papers.

By utilizing advanced AI technologies like the Llama2 language model and LangChain framework, QPGen allows educators to input parameters such as subject, difficulty level, question format, and module in order to generate a tailored question paper. The system automatically balances the content distribution while features like question editing and regeneration enhance its effectiveness. Evaluations prove that QPGen significantly reduces the time and effort spent in preparation whilst keeping up the quality of assessment, thus allowing teachers to teach and innovate in academic workflows. QPGen has been tested for performance based on question type, achieving 92.3 percent accuracy for descriptive questions, 77.2 percent for single-sentence questions, and 51.9 percent for multiple-choice questions, with scope for improvement. It offers features like question editing and regeneration for better customization. Future enhancements include integrating Bloom's taxonomy levels and allowing users to upload specific subjects for tailored question generation.

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Chapter 1

Introduction

The designing and formulation of exam question papers are a long-established central area of educational assessment; nevertheless, this process has always remained laborious and time-consuming. These challenges have prompted the adoption of advanced computational technologies such as AI for the transformation of question paper generation. Upon automation, this enables the teacher to concentrate more on teaching and mentoring students while ensuring a quality assessment. This chapter describes the nature of various technological frameworks like the AI-driven models, language models like Llama2, or traditional rule-based ones, demonstrating their impact on university workflows.

Examinations are central to the system of education and act as the most important tool for evaluating students' grasp of knowledge and understanding of progress. But conventional methods of setting examination papers have often suffered from inefficiencies, inconsistencies, and limited flexibility in meeting varying academic needs. Until now, teachers have relied on traditional manual ways of doing things that consume human resources and time, are prone to human errors, lead to inconsistent coverage of the subject matter material, and present a challenge in establishing an appropriate level of difficulty.

The introduction of AI technologies has revolutionized this space, enabling automated creation of customizable and structured question papers. Advanced models such as Llama2 can excel at understanding curriculum requirements, generating diverse question types, and providing balanced coverage of topics, alongside the regeneration and editing options that allow educators to further hone such generated content in line with academic goals and standards.

Using these developments, educators will have the option to conduct custom assessments, assure exams uphold fairness, and eradicate work for manual paper preparations. This study looks at many advanced methods and their modalities, challenges, and application. It emphasizes how these collectively enhance academic functioning in creating efficient, scalable, and quality systems for examinations.

1.1 Motivation

Crafting examination question papers is a slow and tedious process that requires a great deal of thought in subject coverage, difficulty levels, and types of question under consideration. The manual process is time-consuming, unwieldy, adding burden to educators and administrative personnel. The project primarily seeks to change the examination question paper assignment by incorporating cutting-edge AI to automate and streamline this all-important academic activity.

QPGen utilizes large language models and advanced frameworks like LangChain to dynamically create sets of varied and well-structured question papers suitable to specific requirements. With added customization options-subject, difficulty level, and question format- the solution is flexible and will waste lesser time for quality work.

The joint project will provide a sublime offering to delve into the whole circumference that revolves around machine learning and web development. It makes one ready with varied skills, like deployment of AI models, back-end development employing Flask, and database management through MySQL. The overall contribution towards quality improvement in educational efficiency and accessibility gives the project a dual approach to modern instruction technology and community outreach. Apart from it, it contributes to furthering the ongoing research on automated evaluation tools, consequently dramatically advancing the eventual future of academic assessment.

1.2 Objectives of the project

This section covers the main objectives of the project and they are as follows:

1. Customization and Flexibility Educators can create their own examination papers by separating parameters in the system such as subject, difficulty, modules, and question format, enabling them to create tailor-made examinations.

2. Automated Creation of Examination Question Papers Utilizing an AI-based system, the examination question papers could be generated with minimum human involvement, greatly alleviating the time and efforts required to design question papers manually.

3. Balanced and Intelligent Selection of Questions The system ensures that a structured mix of questions is intelligently selected, providing fairness to different levels of

difficulty and distribution of topics for different assessments.

1.3 Organization of the report

The report is divided into 7 chapters. The first chapter gives an introduction; it discusses the motivation for the project and its objectives to give a clear understanding of the project's main purpose. The literature survey will deal with the previous research and knowledge regarding the domain of this project in Chapter 2. System requirements and specifications are stated in chapter 3, details concerning both its functional and non-functional requirements, as well as hardware and software prerequisites. Chapter 4 discusses the proposed solution to the problem followed by Chapter 5, which illustrates the architecture and components of the system. In turn, Chapter 6 develops the comprehensive System overview that has been planned for developing software. The last chapter deals with the system results and presents some outputs of the system; conclusions about the project are placed in Chapter 8.

Chapter 2

Literature Survey

From the reference [1] author have given a solution to problem of Traditional question paper generation which takes more time and may not fully optimize the assessment process. The paper includes an innovative approach to question paper generation,leveraging the power of Artificial Intelligence and Natural Language Processing techniques.It includes AI algorithms and NLP models to automate and question paper generation process.They have extracted key concepts from textbooks,objectives of the subject.System generates question by extracting plain text then data preprocessing with methods like segmentation , word tokenisation ,parts of speech recognition , tokenisation , lemmatisation. This enhances the NLP model performance during the question generation.In the solution, only Multiple choice and fill in the blank type questions are generated.

Reference [2] presents a tool for generating questions from given paragraphs. The system utilizes the Stanford Question Answering Dataset (SQuAD v1.1) for training, which provides essential stem and base words related to English literature. It employs a Complex Seq2Seq RNN model for data preprocessing and fine-tunes a GPT-2 model (124M parameters) on the SQuAD dataset for question generation. User-provided text is processed through the RNN, which includes text splitting and parts of speech tagging. Testing is conducted using a One Question Per Line model with numbered delimiters, achieving high scores in BLEU2, BLEU3, BLEU4, and METEOR metrics. A limitation of the system is its reliance on memory, as standard systems have limited RAM and GPU computational power.

In reference [3] research deals with Automated generation of questions form the a given passage or paragraph,including multiple choice questions. The use of T5 Transformer model for text summarization provides processing data through tokenizers and beam search. This created precise summaries of uploaded text.KeyBERT model identifies key phrases from the summarised text and with the use of WordNet and Sense2Vec MCQs are generated. The system supports various languages using Polyglot library,making the system applicable globally.They have used PyTorch for deep learning application, Nltk for

tokenization and language processing and random Module to generate random elements for text manipulation.

Reference [4] introduces a web-based tool that leverages the LangChain framework to generate questions. This framework supports large language models and is designed to produce a variety of question types aligned with different cognitive levels to accommodate diverse learning requirements. The system operates by extracting data from uploaded PDF documents utilizing the PyPDF2 library, then processing this data into structured embeddings through techniques such as text chunking, tokenization, stemming, and lemmatization. These embeddings are subsequently stored in a vector database employing FAISS (Facebook AI Similarity Search). Moreover, to enhance its capabilities, the system integrates a ConversationalRetrievalChain for context-aware question generation and utilizes the Google PaLM2 model for precise semantic indexing. The user interface is developed using Streamlit, which enhances the interaction between users and the language model.

Researcher worked on reference [5] suggests a novel approach to query the paper based PDFs. As a ubiquitous task, in this paper the authors address the information extraction problem in unstructured PDF documents. They propose a system using OpenAI Large Language Model (LLM) and Langchain framework where the LLM sits on the backend streamlit web interface is used to reduce integration problems and provide scalability. The system can be used to process the documents up to 200KB, and it reveals the necessity of quality data preprocessing, in order to achieve effective tokenization. The paper proves that the existing AI technologies are able to reduce the need for solving everyday practical document processing tasks and that they should be under exploitation reach.

Chapter 3

System Requirements

In this chapter, the researcher describes the main requirements that need to be addressed for the QPGEN implementation. There are functional requirements and nonfunctional requirements, which essentially define aspects through which the goals of the project can be achieved. The first type includes data extraction and preprocessing, model training, and generation of question reports, while the second looks at the performance of the system, scalability, robustness, and reliability. This chapter should also tell the required hardware and software configurations, including the technologies, tools, and system setups necessary for the system to run smoothly and effectively. By documenting these requirements in unambiguous terms, we give a structured framework to guide the development process, thus ensuring that the objectives of the project are completed successfully.

3.1 Functional Requirements

3.1.1 Generate Questions

This could involve the dynamic generation of questions based on a subject code through model building. This provides educators with the ability to automatically generate exam content.

3.1.2 Data Preprocessing:

The data for a particular subject should be extracted in any PDF format and properly converted to vector embeddings for question generation.

3.1.3 Question Type Versatility

Question types generated by the model are Multiple Choice, Descriptive, and Short Answer questions, providing flexibility to the system.

3.1.4 Module Selection

The user choose one module from 1 to 5 for a particular subject. This enables extracting only the targeted contents with respect to a course.

3.1.5 Difficulty Level

One of the options should allow the system to generate Easy, Medium, Easy. This enables the system to generate question accurately and within the expectations from the institution.

3.1.6 PDF Download

The generated questions should be exported to portal document format. This would allow for simple printing and sharing.

3.1.7 Question Regeneration

If the user is not satisfied with a question the system will generate another set of questions as per the constraints. This is going to aid the system in learning while reaching users' expectations and requirements.

3.2 Non Functional Requirements

3.2.1 Performance

Generation of questions based on the context should only be. System must ensure the process is smooth for its users to gain easy use of it and minimize the amount of waiting time.

3.2.2 Reliability

Another non-function of the system that is reliable is it should run on error handling smoothly. When an error has occurred, it must provide reasonable error messages and will ensure the stability of the system it is running.

3.2.3 User Interface

The system has a consumer-friendly design that allows easy interaction with the user. There are clear pathways for users to execute all the above functions.

3.3 Hardware Requirements

3.3.1 Processor

For operating this system, a CPU with at least an Intel Core i5 or AMD Ryzen 5000 series and above is deemed necessary. It is to support computational complexity AI models. The system has to handle model of 7 billion parameters or its compressed versions.

3.3.2 RAM

To execute model and produce vector form content, the least would be 8GB of RAM; this enables in smooth multitasking and model processing operations.

3.3.3 Storage

Minimum SSD storage must be 256GB. An SSD allows efficient accessing of data and model-by enabling data retrieval access has faster than normal solid disk drives.

3.4 Software Requirements

3.4.1 Backend Technologies

Python3.9+: Pyhton is the primary programming Language for the project which handles the AI model.

Flask: Web framework which is used in the API development and handling.

MYSQL: Relational Database which is required for Syllabus storage and management.

PyPDF2: A python library capable of splitting, merging, cropping and transforming PDF files.

Langchain: A framework which is used to handle Large Language Model and integrate the model with the system.

HuggingFace Embeddings: Embeddings which are required for conversion of text data into the vector format which is part of Natural Language processing.

CTransformers: A model architecture which is used for tasks such as text generation, translation, and sentiment analysis. Here we are using it for text generation.

3.4.2 Frontend Technologies

HTML5: A markup language used to create web pages. It structures the web page.

CSS: Styling language used for design the structured HTML web page.

JavaScript: Used for dynamic and make interactive webpage. It has the ability to change or update the HTML and CSS with user actions.

3.4.3 Operating System

Allow compatibility with Windows 64-bit and 32-bit, so that the software can be flexible and accessible to the user.

3.4.4 Development Tools

VisualStudio: VisualStudio is an Integrated development environment which supports various languages and other dependencies.

MySQL Workbench:A database management interface for several operations.

Chapter 4

Proposed Solution

4.1 Methodology

The methodology for our project involves a series of steps aimed at leveraging advanced AI techniques to automate and optimize the exam question paper generation process:

- **Requirement Analysis and Dataset Preparation:** Analyze academic requirements by collecting syllabi, past question papers, and assessment patterns from institutions. Preprocess the collected information by re-organizing it into structured formats, tagging topics and difficulty levels and types of questions that meet curriculum needs.

- **Preprocessing:** Tokenize the input data, leading to clean and normalized text. Embeddings of the syllabus content are created using Hugging face sentence transformers, intending to facilitate intelligent question generation.

- **Model Development:** Use advanced language models such as Llama2 for generating diverse and well-structured questions. Have a feedback-disab:ed mechanism whereby the user can give feedback to refine the questions generated such that they would be of better quality and relevance. Use LangChain or any other framework to train the model to manage large datasets and generate questions that are relevant to context.

- **User Interface and System Development:** Develop an interactive web application, using Flask for the backend processing and HTML, CSS, and JavaScript for the frontend. These user-oriented features include parameter selection (for subject, difficulty level, question type, and modules, etc.) and realtime previews of the generated question paper. Allow regeneration and editing.

- **Deployment:** Deploy the application locally or on the server for demonstration purposes, in a manner such that the application should not malfunction or be in-

accessible during development. On the backend application, the trained AI model has to be integrated to take in user requests to dynamically generate the question papers. There should also be options for the user to download their final question paper in PDF or Word.

4.1.1 Proposed System Architecture

QPGen uses LLM-LLama 2, PostgreSQL, FAISS, and Hugging Face models, most automatically generating question papers. A user input fetches syllabus data from mySQL, passes through a Text Splitter, and then stores embeddings generated by FAISS for retrieval. Queries are to extract relevant context and allow LLMs to generate structured questions that can Download, Edit, or Regenerate it.

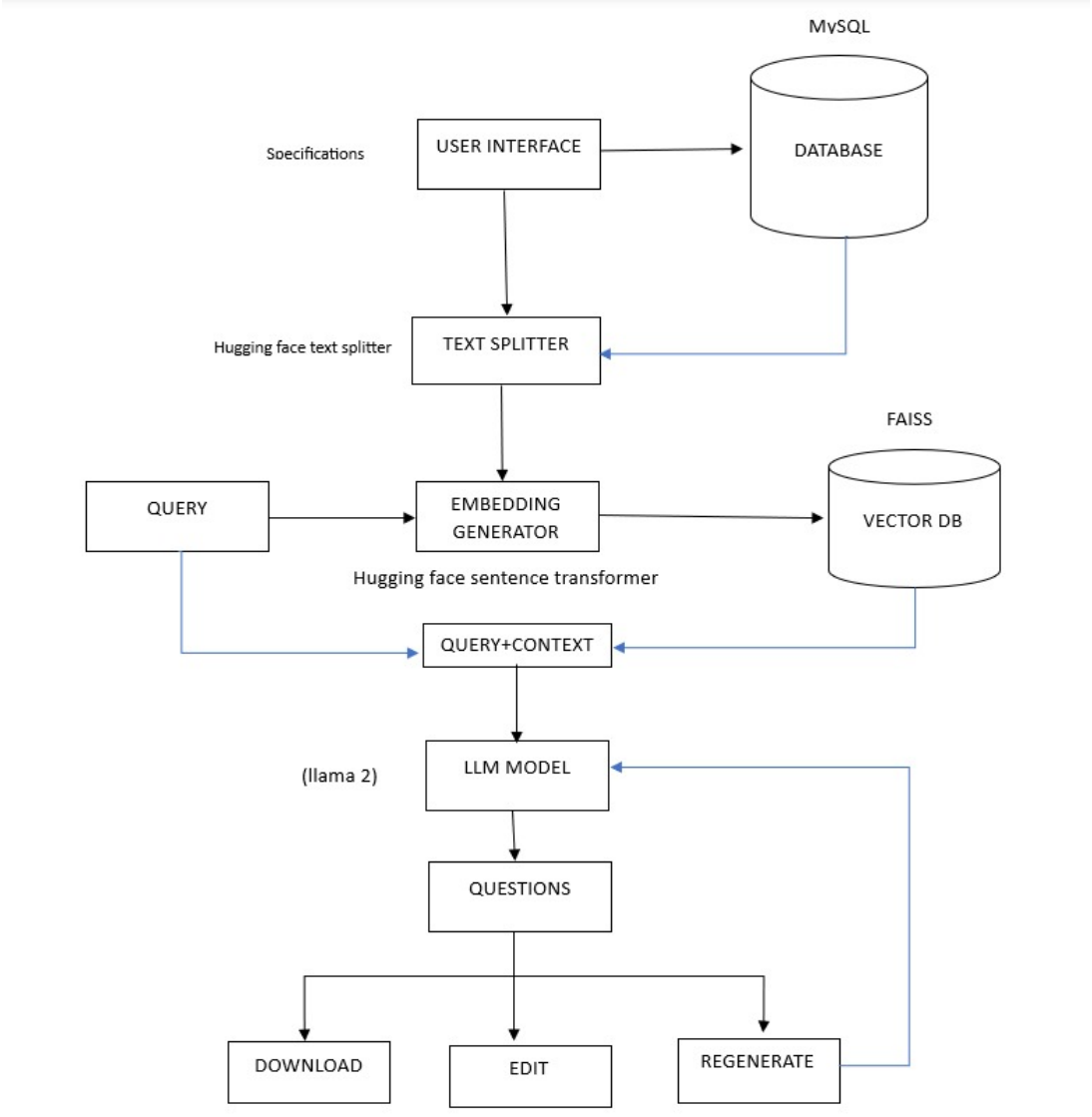

Figure 4.1: Proposed System Architecture

Chapter 5

System Overview

QPGen leverages the insight that AI-based tools can provide an innovative solution by automating the process of generating the paper. It works challenges like variety of questions, balancing the difficulty, and the alignment of the syllabus to allow a teacher to create quality papers based on the academics' needs.

5.1 Key Components

5.1.1 Data Collection and Preprocessing

The system is built on the set of curated datasets of questions in various subjects and difficulties. This serves as the input to create some valid structured questions during training.

Preprocessing Steps:

- **Data Standardization:**It provides consistent formatting and all the tags to ensure effective training.
- **Text Cleaning:** It eliminates repetition and unifies the format of the questions..
- **Data Augmentation:**There are some variations of the organized texts and structural formats, introducing diversity.

5.1.2 Model Architecture

QPGen harnesses a transformer-based language model (Llama2). This state-of-the-art NLP tool enables the generation of seamless and contextually relevant questions.

Key Features of the Model:

- Self-attention mechanisms for understanding key elements, such as topic, difficulty, and format.
- Fine-tuning on academic datasets for optimized performance.

- Custom prompts developed for multiple-choice, descriptive, and short-answer questions.

5.1.3 Question Generation Process

Its structured pipeline presents the steps:

- Parsing user inputs such as subjects, syllabus, type of question, and level of difficulty.
- Question formulation in alignment with the context using the LLM.
- Formatting of the generated questions and presenting for review.

5.1.4 Evaluation and Optimization

- **Perplexity Reduction:**Ensures grammatically and contextually accurate outputs.
- **Hyperparameter Tuning:**Optimizes learning rate, batch size and performance.

5.2 Block Diagram

The system is divided into 4 blocks which plays a crucial role in the project.

5.2.1 TextSplitter

The data obtained from the MySQL database consists of various-sized content in pdf. The model cannot do processing on the variable-sized data. So, we will take the text from the pdf and split it into small-sized chunks of the same size using textSplitter. We are using langchain textSplitter which converts the bytes of data into a fixed size while retaining the order and meaning of the data.

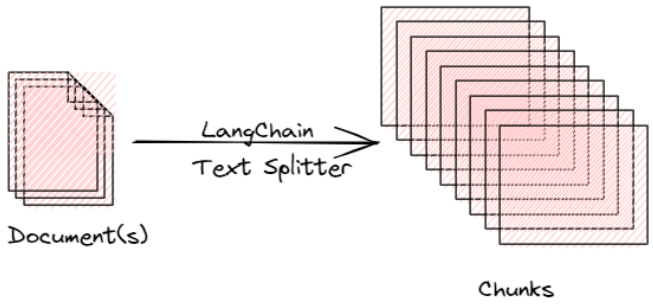

Figure 5.1: Block Diagram of the Proposed System

5.2.2 Embedding Generation

The text is natural language format, but machines understand only binary. Prep work is needed to extract important text from the data: morphological analysis, in the way of lemmatizing, stemming, and part-of-speech tagging. The data needs to be actually vectorized into numerical representations. The embeddings have to layer on each other in a neural arrangement.

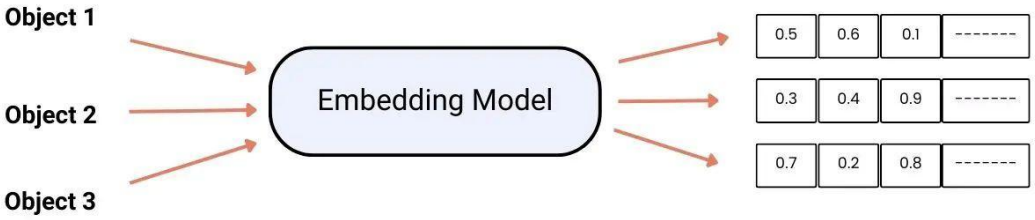

Figure 5.2: Embedding block diagram

5.2.3 Vector Database

The entire embedding scenario is stored somewhere else. Traditional storage systems cannot handle vector forms of data; and so a vector database is employed. Vector database stores all the embeddings, which are provided by the sentence transformer. One database is from Facebook AI for Similarity search, is easy to maintain, and is compatible with the llama2 model. Therefore we use FAISS.

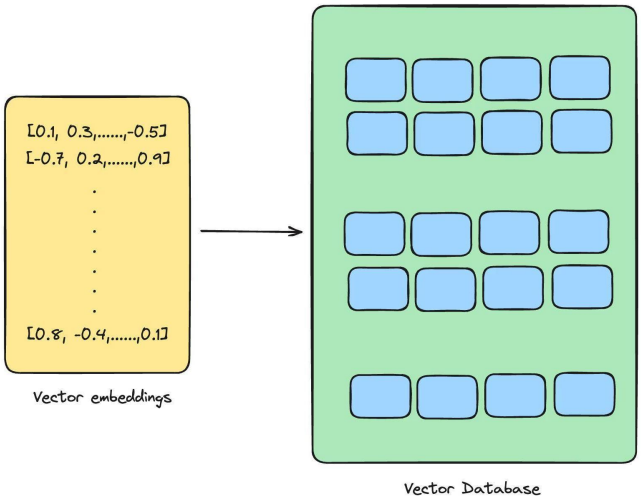

Figure 5.3: vector Database block diagram

5.2.4 Large Language Model

All the data which is present in the vector database and according to user query the system has to generate the questions. The key words in the text and other supporting text are generated by the system by the use of Large Language model.The model has to perform multiple forward and backward feedback mechanism to generated the questions.The process is highly time consuming and important phase of the system.we are using llama2 model which is open source and easy to handle.

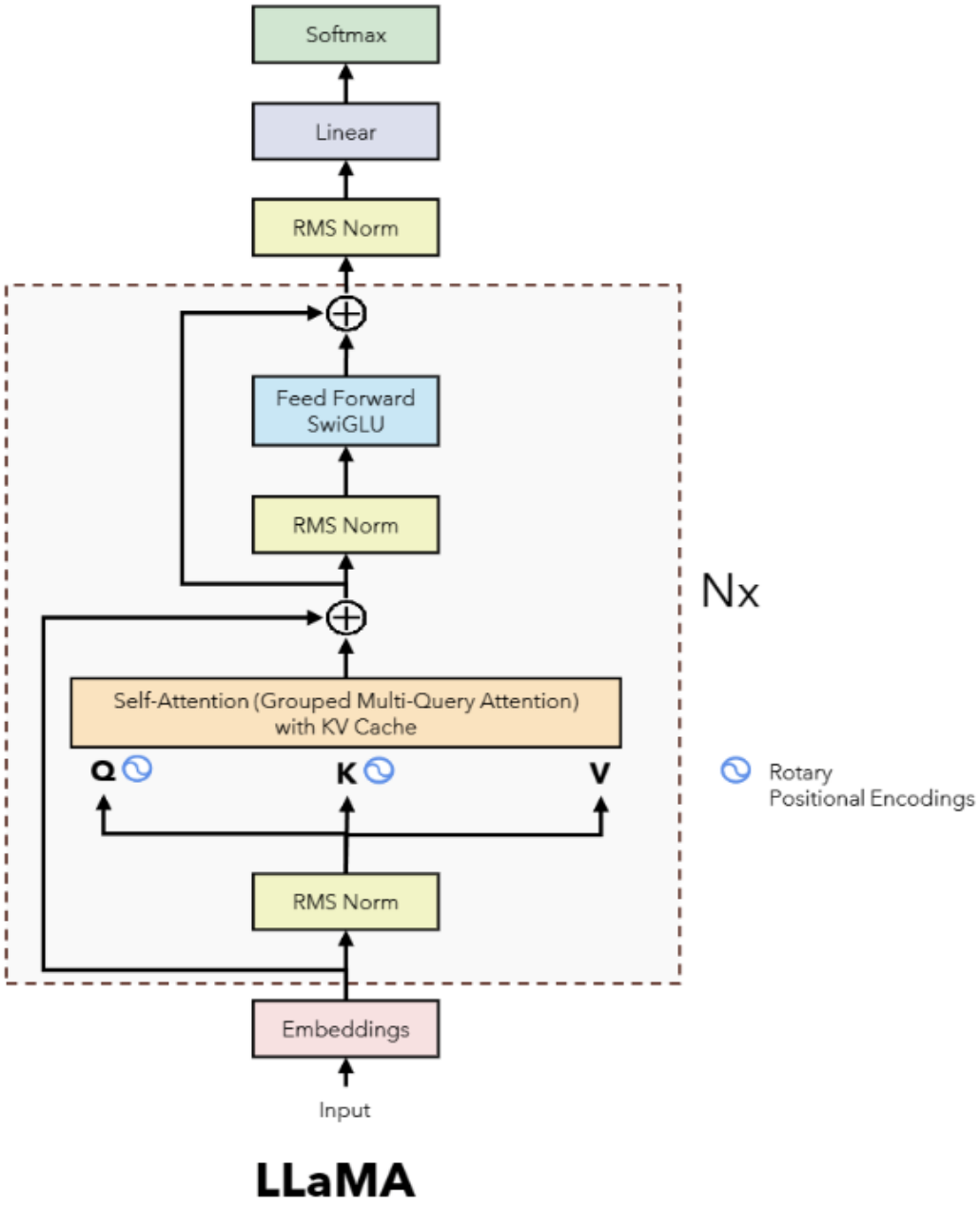

Figure 5.4: llama2 block diagram

Chapter 6

System Software

The QPGen system utilizes advanced software tools and frameworks to enable efficient question paper generation. The architecture combines backend development, database management, and LLM-based question generation to deliver an intuitive and scalable solution.

6.1 Key System Processes

6.1.1 Data Preprocessing

- Extract syllabus and related content from the MySQL database.
- Clean and standardize the data using tokenization and lemmatization techniques.

6.1.2 User Input Handling

Users provide:

- Subject code and module details.
- Desired question types and difficulty levels.

6.1.3 Integration with LLM

- User inputs are processed by LangChain.
- The LLM generates a structured set of questions tailored to the input criteria.

6.1.4 Output and Feedback Mechanism

- Generated questions are displayed via the web interface.
- Users can edit or regenerate questions if needed.
- The final set of questions is exported as a PDF.

6.2 Advantages and Limitations

6.2.1 Advantages

- Saves significant time and effort compared to manual question paper generation.
- Ensures balanced content distribution across topics and difficulty levels.
- Allows customization and refinement of question papers.

6.2.2 Limitations

- Requires manual input of syllabus data into the database.
- Limited flexibility for generating highly specialized question formats.

6.3 Flowchart

The flowchart illustrates the workflow of the QPGen system for automated question paper generation. Users input the subject code, module, question type, and difficulty level through the user interface. This data is retrieved from the MySQL database and processed into vector storage. The LLM (Llama 2) then generates structured questions based on the retrieved context. Users can either regenerate, edit, or download the final set of questions as a PDF, ensuring flexibility in question paper customization.

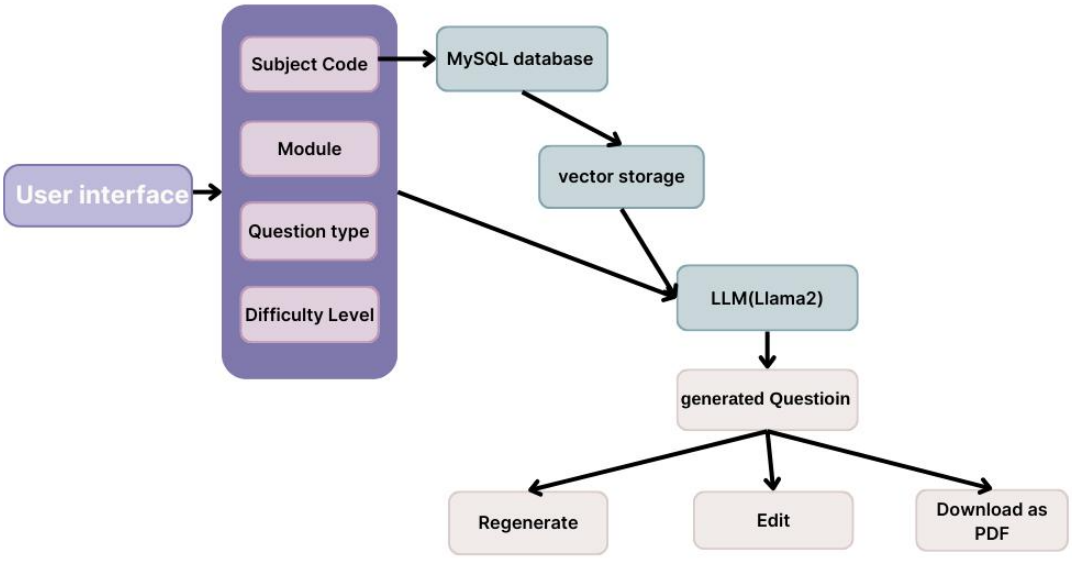

Figure 6.1: Flowchart of the Proposed System

Chapter 7

Results

7.1 Performance Analysis

The analysis in QPGen evaluates the performance of the AI model in question papers generation based on certain specified parameters. Performances were given grades based on quality measures, including diversity of questions, distribution of difficulty, and relevance to instructional objectives. Continuous analysis of these performance parameters allows for the improvement of the AI models in terms of eliminating inconsistencies and enhancing their ability to produce good quality, tailored question papers that serve academic purposes.

Performance of the system predominantly depends upon three factors:

1. **Question Type**: As for question type, the kind of question formed by the model, whether MCQ, short answer, or long answer, determines the performance of the AI. Nice question-grading allows for the AI model's success by producing versatile and subjectively appropriate question types as per the given input parameters.

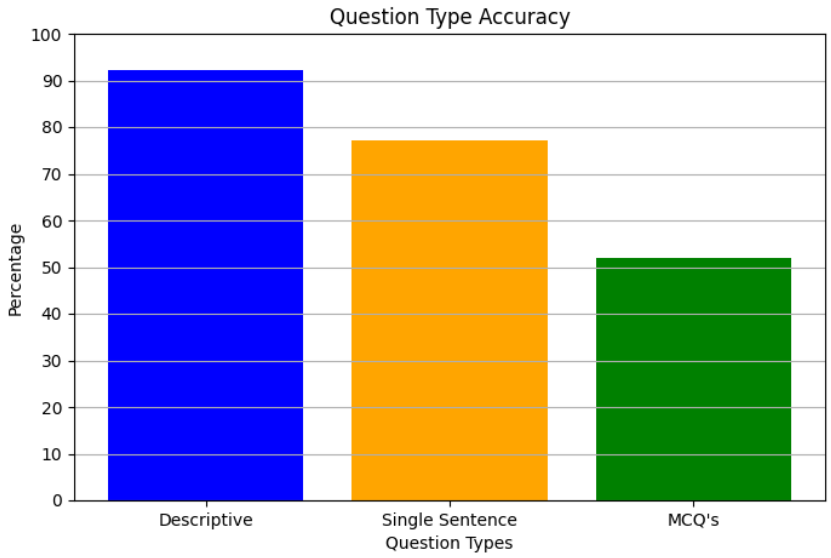

Figure 7.1: Accuracy based on Question type

The system was tested several times using different syllabi and subjects. By taking random sampling from the data, we calculated the accuracies of the questions according to their type. The system generates meaningful questions with a 92.3 percent accuracy in descriptive questions, 77.2 percent correctness in one-sentence questions, and 51.9 percent success in multiple-choice questions. This means that the model is performing well for descriptive and single-sentence questions, while it does require further training to do better with multiple-choice questions.

2. **Question Diversity**: Question paper diversity in mode guarantees multiperspectival topics in question papers. The more diverse the question range, the more thoroughly its paper can evaluate the student.

3. **Difficulty Distribution**: The Role of AI, given its unique ability to balance question difficulty according to preset parameters, comes alive. Questions should be spread through a range of settings in the degree of difficulty, allowing different abilities of students to use the same paper.

7.2 Question Quality

- **Descriptive Type Questions**: The system exhibited high accuracy in generating descriptive-type questions, achieving an accuracy of 92.3 percent, indicating its strong performance in creating meaningful and contextually appropriate questions. This high accuracy is attributed to well-structured context, as descriptive questions allow for open-ended responses, reducing the impact of minor variations on accuracy. Additionally, the model was trained with diverse input data, ensuring alignment with academic standards and syllabus requirements. The generated questions effectively covered all five modules of SEPM (Software Engineering and Project Management) and were verified against syllabus content. You can see the descriptive questions for all five modules from the subject SEPM below.

- **Module 1:**

  1)How will you ensure the quality of code generated during the plan execution stage? (Elaborate)

  2)What are some common pitfalls to avoid when carrying out the plan for software design? (List at least 3)

3)Can you describe a situation where testing and quality assurance would be particularly crucial in the software development process? Explain.

4)How does the plan execution stage relate to the overall software development life cycle? (Explain)

5)What are some ways to improve communication among stakeholders during the carry-out-the-plan stage? (List at least 2)

- **Module 2:**

1)How does one measure the effectiveness of custom software development projects? Provide three (3) possible metrics you could use to evaluate success.

2)Give a real-world example of how custom software has helped solve a problem or improve business processes for an organization.

3)How does the cost of custom software development compare to off-the-shelf software solutions? Provide a rough estimate.

4)What are some common misconceptions about custom software development projects? Provide two (2) examples.

5)How does the complexity of a business problem influence the type of custom software solution that is needed?

- **Module 3:**

1)What are the potential benefits of developing custom software for a business?

2)How can you measure the success of a custom software development project?

3)Who will be interested in using the software to be built?

4)Can you describe the main features and functionalities of the software?

5)What are the possible alternatives to developing custom software for a business?

- **Module 4:**

1)What are some of the reasons why organizations might consider developing custom software rather than using off-the-shelf software?

2)Can you identify a measurable benefit that may be achieved through the successful implementation of the software being developed?

3)Who do you think will have an interest in the software to be built? Identify at least three groups of people.

4)What are some possible alternatives to custom software development that orga-

nizations might consider? Explain the advantages and disadvantages.

5)Can you describe a situation where custom software development may not be the best solution? Provide examples.

- **Module 5:**

  1)Who are the intended users of the software to be built?

  2)Can you describe a measurable benefit of a successful implementation of the software?

  3)Are there any alternatives to custom software development that could address the problem?

  4)How will the software support or enhance the operations of the organization?

  5)Are there specific business processes or procedures that can be automated with the software?

- **Single Sentence Type Questions**:The system achieved an accuracy of 77.2 percent in generating single-sentence questions, with good overall performance but minor inconsistencies in sentence structuring and phrasing due to challenges in conciseness and context dependence, where some questions lacked clarity or had slight wording variations affecting accuracy. You can see the single-sentence questions generated below for all five modules of the Artificial intelligence and machine learning subject.

- **Module 1:**

  1)What was Cordell Green's contribution to artificial intelligence?

  2)What was the Shakey robotics project at Stanford Research Institute and why was it significant?

  3)How did the Shakey robotics project demonstrate the integration of logical reasoning and physical actions?

  4)Name any two key concepts related to AI that were demonstrated by the Shakey robotics project.

  5)What is Cordell Green's question answering system, what is it used for and how does it work?

- **Module 2:**

1)What is the main focus of Cordell Green's question-answering and planning systems according to (Green, 1969b)?

2)Which project was the first to demonstrate the complete integration of logical reasoning and physical action, as discussed in Chapter 25?

3)Can you identify the source of the information that provided the inspiration for Cordell Green's question-answering and planning systems?

4)In what way did the Shakey robotics project demonstrate the integration of logical reasoning and physical action?

5)Can you describe Cordell Green's question-answering and planning systems in your own words?

- **Module 3:**

1)Which component was essential for the development of Green's question-answering system?

2)Can you explain the concept of integration of logical reasoning and physical manipulation in the context of Shakey robotics project?

3)What was the significance of Shakey robotics project in the field of artificial intelligence?

4)What is the main difference between Cordell Green's approach and contemporary approaches to question answering?

5)Can you explain how Shakey robotics project contributed to the development of modern-day AI systems?

- **Module 4:**

1)What is a decision tree, and how is it used for classification tasks?

2)What is the curse of dimensionality, and how does it affect machine learning models?

3)How does feature selection contribute to dimensionality reduction?

4)What is feature derivation, and how does it differ from feature selection?

5)What is the Gini impurity, and how is it used in CART?

- **Module 5:**

1)What are the Aikake Information Criterion (AIC) and Bayesian Information Criterion (BIC)?

2)How does the k-nearest neighbors (k-NN) algorithm classify new data points?

3)What is the curse of dimensionality, and how does it affect nearest neighbor methods?

4)How does k affect the decision boundary in k-NN classification?

5)What is nearest neighbor smoothing, and how is it used in regression?

- **MCQ'S Type Questions**:The accuracy of MCQ generation was 51.9 percent , indicating that while the model successfully produced questions, it struggled to provide varied and distinct answer choices. Some questions had repetitive options, making them less effective for assessment purposes. This lower accuracy was primarily due to repetitive answer choices, where several MCQs contained similar or incomplete options, reducing question diversity. Additionally, the model sometimes failed to generate distinctive distractors (incorrect answer choices), leading to answer options that were too similar or misaligned with the question. You can see the MCQ questions for all five modules from the subject DBMS below.

- **Module 1:**

1. What is a database? a) A collection of records b) A collection of files c) A collection of data d) A collection of queries

2. What is the purpose of a database management system (DBMS)? a) To organize data b) To store data c) To manage data access d) To execute queries

3. What is a query in a database? a) A question asked to retrieve data b) A command to modify data c) A request to insert new data d) A request to delete existing data

4. What is the difference between a table and a file in a database? a) A table stores data, while a file stores programs b) A table stores records, while a file stores data c) A table stores information, while a file stores files d) A table stores queries, while a file stores data

5. What is a primary key in a database? a) A unique identifier for each record b) A group of columns used to retrieve data c) A field that contains the date and time of creation d) A field that contains a description of the data

- **Module 2:**

1. Which of the following is NOT a type of query? a) Update Query b) Insert

Query c) Select Query d) Delete Query

2. What is the purpose of a join operation? a) To combine data from two tables into one table b) To separate data from two tables into different tables c) To modify data in a single table d) To create a new table with data from multiple sources

3. What is the difference between a primary key and a foreign key? a) A primary key is a unique identifier for each record, while a foreign key is a reference to a table that contains the same information b) A primary key is a reference to a table that contains the same information, while a foreign key is a unique identifier for each record c) A primary key is used to identify records, while a foreign key is used to link related data across multiple tables d) A primary key is used to link related data across multiple tables, while a foreign key is used to identify records

- **Module 3:**

1. What is a query? Is it(a) a request to access data (b) an inquiry for details(c) a command to modify data (d) a message sent to a database.

2. How many files are stored in the "STUDENT" file? (a) 5 (b)10 (c) 15 (d) 20

3. How are queries organized in the system? (a) By type of data (b) By location(c) By user (d) By date.

4. What does the term "modifying" mean in this context? (a) To create new data records (b) to update existing ones (c) to delete old records (d) all of the above.

5. How many records are stored in each file in the system? (a) 10 (b) 20 (c) 30 (d) 40

- **Module 4:**

1. Which of the following is NOT a type of query? a) Select query b)Insert query c)Update query d)Delete query e)Modify query

2. What does the term "query" originally mean? a) A request or inquiry b) A command or instruction c) Data records d) A database

3. Which file stores data records of the same type in the given example? a) TEACHER file b) STUDENT file c)CIVIL file d) All of the above

4. Which of the following best describes the content of the passage? a) The different types of database management systems available b) The steps involved in creating a new database c) The importance of queries in database management d) The history

of databases and their evolution

- **Module 5:**

  1. Which of the following is NOT a query operation? a) Retrieving data from a database b) Adding new records to a database c) Modifying existing records in a database d) Displaying data on a screen for viewing e) Printing data from a database

  2. What is the purpose of a WHERE clause in a query? a) To specify fields or data sources in addition to those listed in the FROM clause b) To limit the data returned by the query based on conditions specified in the clause c) To group records according to certain characteristics d) To sort the records in ascending order e) To create a summary of the data

  3. How is an index created in a database? a) By creating a separate table for the index b) By specifying the columns and fields that will be included in the index c) By using a specific indexing tool or method d) By adding an index to an existing table e) By combining multiple indexes from different tables

7.3 Result Snapshots

7.3.1 Front Page

The front page of the system looks like this, it has the user interface where user can select the different parameters like subject code, question type, difficulty level and the module on which question need to be generated.

7.3.2 Question Generation and Additional Features

After submitting a request, the model generates and displays questions on a dedicated page as shown in Figure 7.3. Users can choose from three options: **Regenerate**, **Edit**, and **Download**. The **Regenerate** option creates a new set of questions, while the **Edit** option allows modifications to the generated questions. The **Download** option enables users to save the question paper as a PDF, with the structure shown in the figure 7.4.

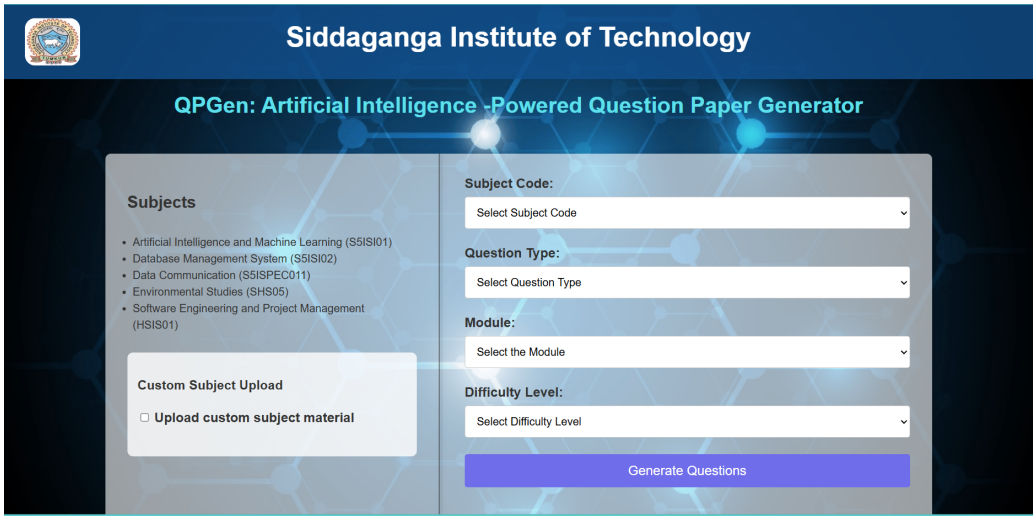

Figure 7.2: Front page of the website

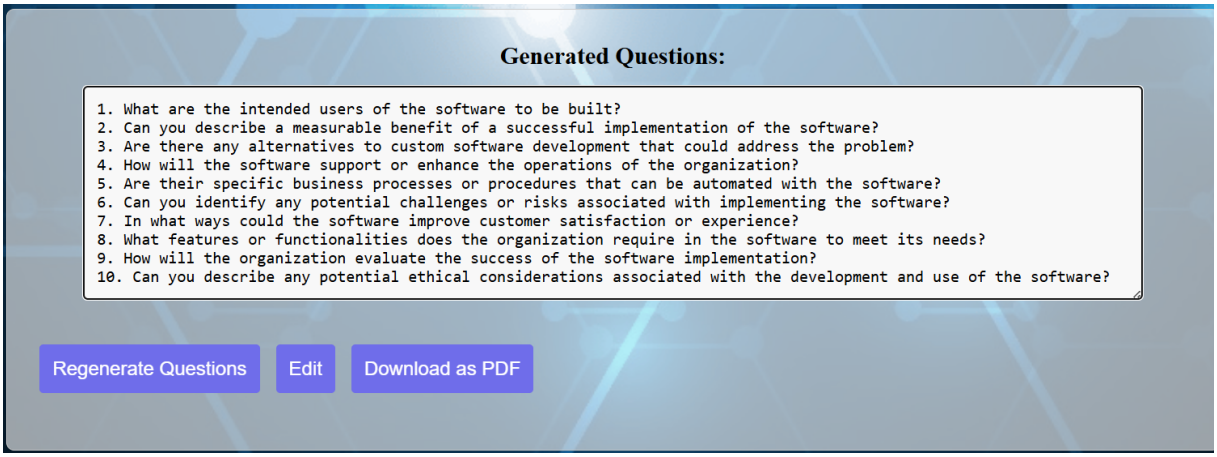

Figure 7.3: Question generated page

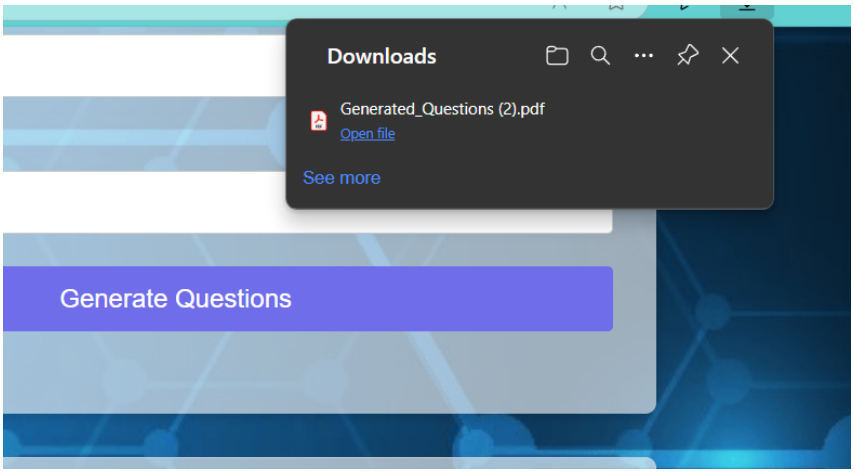

Figure 7.4: view of downloaded pdf

7.3.3 Result

The below table highlights key performance metrics for the "QPGen" system, including Data Collection (accurate question retrieval), Question Diversity (varied difficulty and

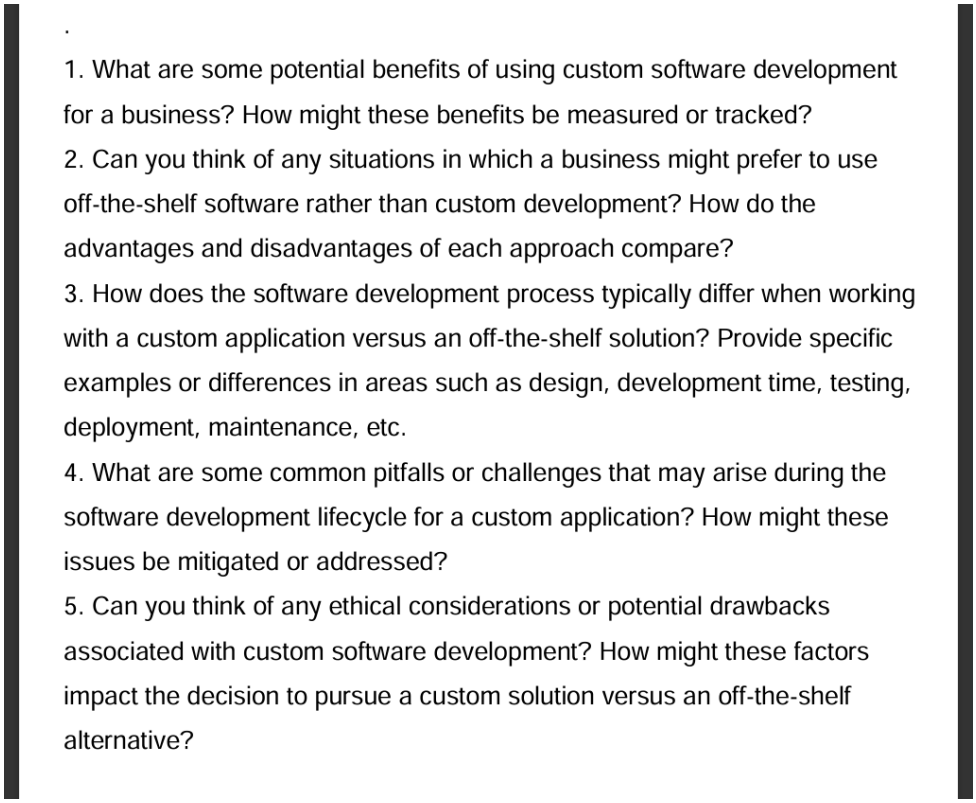

Figure 7.5: Downloaded pdf data

topics), Personalization (customizable question papers), and Relevance Matrix (alignment with user-defined requirements). It maps these metrics to the model's capabilities, showcasing how QPGen meets user needs effectively.

Matrix	Reason	Our Model
Data Collection	It depends on how accurately and comprehensively the questions are retrieved from the database.	Dynamically extracts and generates questions tailored to user requirements.
Question Diversity	Ensures inclusion of various difficulty levels and topics in the question paper.	Questions are generated based on user-selected difficulty and topic preferences.
Personalization	Allows customization of the question paper based on specific user needs.	Users can specify the number of questions, topics, and question formats.
Relevance Matrix	Measures how well the generated questions match the specified requirement	Questions are aligned with user- defined parameters like syllabus and topics

Chapter 8

Conclusion

The QPGen project successfully developed an AI-powered system to automate exam question paper generation using Llama2 and LangChain. It ensures customizable, well-structured, and balanced questions while reducing manual effort. With a focus on data preprocessing, model design, and validation, the system enhances content quality and aligns assessments with educational standards. Its user-friendly interface enables easy adoption, demonstrating AI's potential to streamline and modernize traditional education processes.

8.1 Scope for Future Work

Future improvements for QPGen include integrating Bloom's Taxonomy to ensure cognitive alignment of questions, enhancing user interaction with a feedback mechanism, and developing a mobile-friendly platform for on-the-go access. Expanding multilingual support will make the tool accessible to educators from diverse backgrounds, while aligning questions with Program Outcomes (POs) and Course Outcomes (COs) will help meet accreditation standards. These enhancements will further refine the system's effectiveness and usability in modern education.

8.1.1 Future Expansion Opportunities

Incorporating these enhancements into future iterations will broaden the scope and impact of the project. Expanding the application to support diverse academic disciplines, integrating advanced cognitive frameworks, and improving usability will ensure that the system remains an invaluable tool for educators and institutions. These advancements will elevate the educational experience and promote innovative teaching methodologies on a global scale.

Chapter 9

Self-Assessment of the Project

9.1 Self-Assessment of the Project

	Level
Poor	1
Good	2
Excellent	3

PO PSO	**Contribution from the project**	**Level**
Engineering Knowledge Knowledge of mathematics, engineering fundamentals, and engineering specialization to form complex engineering problems.	Applying Embeddings and Transformers to perform text generation tasks.	3
Problem Analysis Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.	Text splitting and vector embeddings using Natural Language Processing and automatically perform semantic search in neural network for text generation.	3

Design/Development of Solutions Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon, culture, society, and environment as required.	Learn Large Language Model and develop a code according to the problem statement. Converting text into embeddings and analyzing neural network using LLMs, transformers and HuggingFace Embeddings	3
Conduct Investigations of Complex Problems Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modeling, analysis & interpretation of data to provide valid conclusions.	Project work is carried out by understanding the concepts of Tranformers and Large Language Models. Neural Network and embeddings which are crucial part of Natural Language Processing which helps in question generation.	3
Modern Tool Usage Create, select and apply appropriate techniques, resources, and modern engineering & IT tools, including prediction and modeling recognizing their limitations to solve complex engineering problems.	Project was carried out using GOOGLE COLAB, Hugging face, Langchain and VS code which is Integrated Development Environment.	3

The Engineer and the World Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to the economy, health, safety, legal framework, culture, and environment.	It is a cost-effective and automated process.To reduce the human effort in question paper preparation and maintain the quality questions throughout the paper. This helps in reducing human interference and paper leaking.	3
Ethics Apply ethical principles and commit to professional ethics, human values, diversity, and inclusion; adhere to national & international laws.	Project work and report followed honor code which is verified by Plagiarism check (25%) and report conforming to Industry standard	3
Individual and Team Work Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.	Equal and active participation is done among the team members	3
Communication Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.	Effective documentation is done using LaTeX (Overleaf) and presented using a structure easy to understand. Effective presentation is also prepared highlighting the novelty, design solution, result analysis, and inference giving directions for further improvement	3

Project Management and Finance Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects in multidisciplinary environments.	Scheduling and plan of action was prepared at the beginning. Plan of action and implementation was recorded in a diary maintained. Execution was done using a cost-efficient, scalable, and customizable approach	2
Life-long Learning Recognize the need for, and have the preparation and ability for independent and life-long learning, adaptability to new and emerging technologies, and critical thinking in the broadest context of technological change.	As the project is about ongoing and upcoming technologies, Large Language Models which are applied to perform various tasks like content creation, customized application development.This helped us to understand the scope of AI and opportunities for development.	3

PSO1 **Computing System**: Demonstrate the knowledge of evolving hardware and/or software to develop solutions to real life computational problems with a focus on performance optimization.	Applied and analyzed AI algorithms to automate question paper generation. The system ensures performance optimization by leveraging efficient software frameworks to create well-structured exam papers dynamically.	3
PSO2 **Communication and Security**: Design and develop solutions for providing efficient transmission, storage, security and privacy of data in diverse computing environment.	Developed a secure system for managing, storing, and transmitting generated question papers.	3
PSO3 **Information management**: Apply tools and techniques for management of information system, data analysis and knowledge discovery in the process of decision making.	Used data analysis techniques to generate question papers tailored to specific curriculum requirements, ensuring efficient and accurate results.	3

Sustainable Development Goals Addressed in the Project

SDG	**Level**
No Poverty	
Zero Hunger	
Good Health and Well-being	
Quality Education	2
Gender Quality	
Clean Water and Sanitation	
Affordable and Clean Energy	
Decent Work and Economic Growth	1
Industry, Innovation and Infrastructure	2
Reduced Inequalities	
Sustainable Cities and Communities	
Responsible Consumption and Production	1
Climate Action	
Life Below Water	
Life on Land	
Peace, Justice and Strong Institutions	2
Partnerships for the Goals	

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Appendices

Appendix A

Data Sheet of component 1

Note: Only include relevant details of the components that are referred w.r.t. project.

Appendix B
Data Sheet of component 2