Personalized Travel Assistant for 21ˢᵗ Century explorers

"Unleash the explorer within you with our immersive travel app."

Utkarsh Raj

Batch-SB-23-7-1

10 July 2023

Task-0

"The real voyage of discovery consists not in seeking new landscapes, but in having new eyes."

- Marcel Proust

ABSTRACT

We have seen drastic evolution in science and technologies in last decade. One such budding technology is Machine learning. Machine learning has emerged as a transformative technology with the potential to revolutionize various industries, and the tourism industry is no exception. There are many forms of Data in Tourism industry, i.e.: Photo, Video, Text, Statistics, Maps etc which can revolutionize tourism industry by assisting in all three stages of each tourism cycle- Pre, during and Post. The implementation of machine learning in the tourism industry has the potential to revolutionize the way travel companies operate, enhance customer experiences, and drive Local and Major business growth as well. This abstract presents an overview of the implementation of machine learning in the tourism industry and its potential implications.

1.0   <u>Introduction</u>

Ever since the beginning of species- Homo sapiens, Travelling has played a crucial role in designing our Civilization. Humans' curiosity has driven them to new places and thus impacting economies, Socio-cultures and Environment by facilitating exchange of Ideas and Goods.
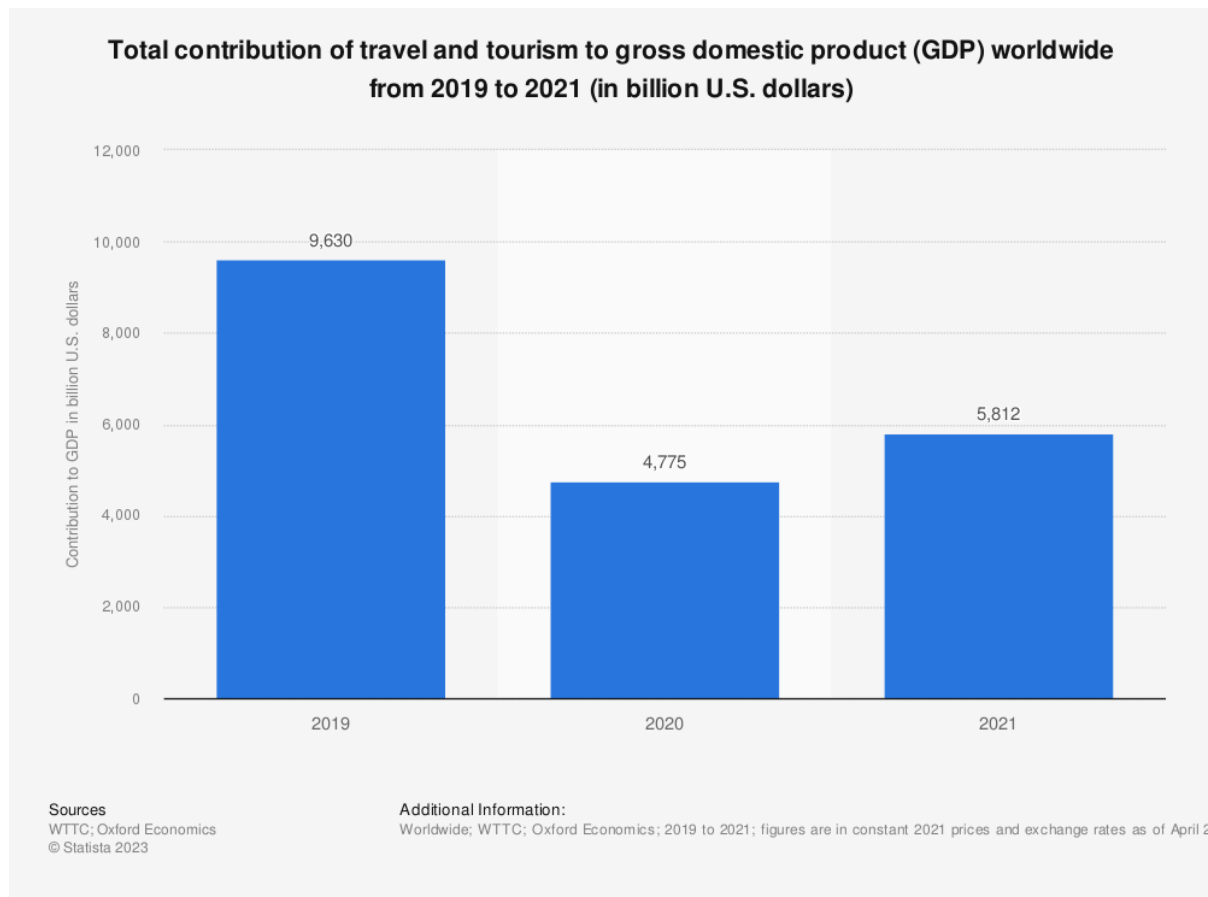
Tourism has enjoyed massive growth over the years, as people seek to spend time away from home in pursuit of recreation, relaxation, and pleasure.

Let's see tourism impacts different aspects of modern civilizations:

A. **Economic impacts: -** Improved tax revenue, personal income growth, enhanced living standards, and the creation of additional employment opportunities.

B. **Sociocultural impacts**: Interactions between people with differing cultural backgrounds, attitudes and behaviours, and relationships to material goods.

C. **Environmental impacts**: Direct effects like Degradation of habitat, vegetation, air quality, bodies of water, the water table, wildlife, and changes in natural phenomena, and Indirect effects, such as increased harvesting of natural resources to supply food, indirect air and water pollution (including from flights, transport and the manufacture of food and souvenirs for tourists).

To get an idea about the scale of this industry, according to the United Nations World Tourism Organization, there were an estimated 25 million international arrivals in 1950. 68 years later, it grew to about 1.4 billion international arrivals, an approximately 56-fold increase.

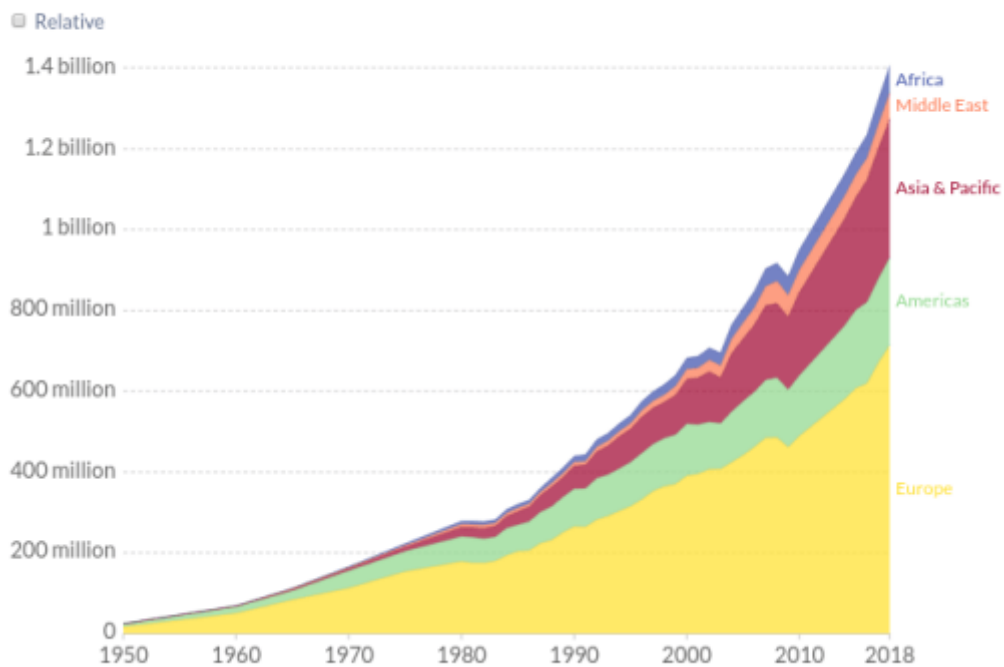According to Statista, total contribution of tourism industry was around $5.8 trillion in 2021 to the global GDP.

Total contribution of travel and tourism to gross domestic product (GDP) worldwide from 2019 to 2021 (in billion U.S. dollars)

Source: Statista

Artificial intelligence is usually defined as a set of technologies that can imitate human intelligence in the process of problem solving (Lai and Hung 2018). In the same vein that airplanes obtain the same result (flying) as birds but use entirely different mechanisms, AI tries to obtain similar results (thinking) as humans but through different mechanisms.

The tourism industry heavily relies on data-driven decision-making to enhance customer experiences, optimize operations, and drive business growth. With the advent of AI/machine learning algorithms and techniques, tourism companies can now leverage vast amounts of data to extract valuable insights and make informed decisions. They can also offer services to their customers for enhanced traveling experience.

International Tourist Arrivals by World Region

☐ Relative

Labels on chart: Africa, Middle East, Asia & Pacific, Americas, Europe

Y-axis: 1.4 billion, 1.2 billion, 1 billion, 800 million, 600 million, 400 million, 200 million, 0

X-axis: 1950, 1960, 1970, 1980, 1990, 2000, 2010, 2018
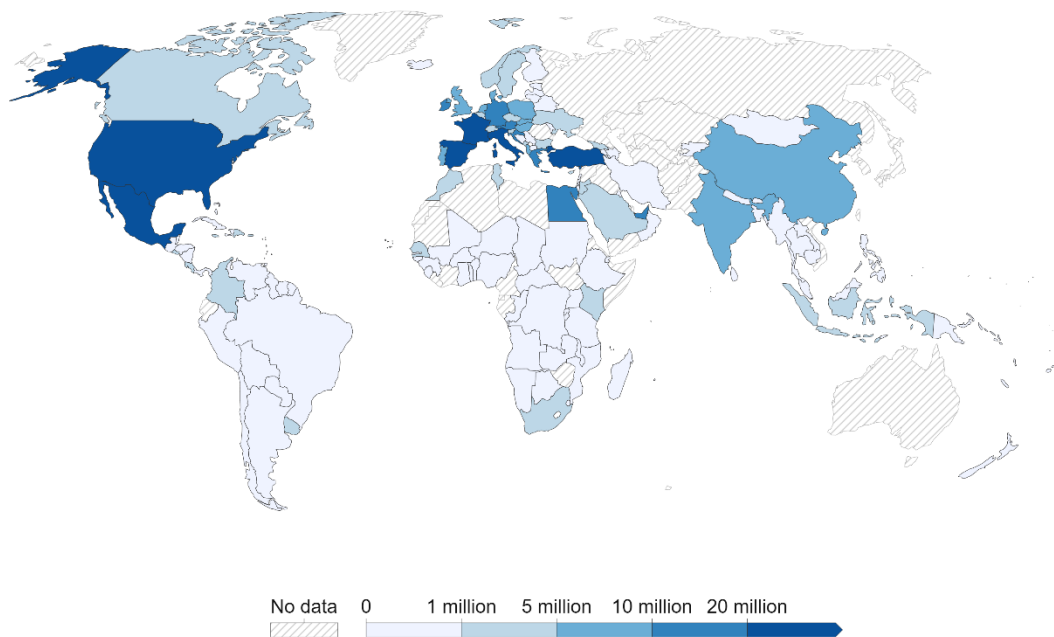
Source: United Nations World Tourism Organization - World Tourism Barometer (2019)   CC BY

International tourist arrivals, 2021

Number of trips by people who arrive from abroad and stay overnight.

No data   0   1 million   5 million   10 million   20 million

Source: United Nations World Tourism Organization (UNWTO, 2023)   OurWorldInData.org/tourism • CC BY

Source: ourworldindata.org

1.1 Problem Statement

Now of-course when there is movement on such massive scale there are going to be many challenges as well which needs to be addressed to improve efficiency, enhance customer experiences, and drive sustainable growth. This problem statement highlights some key issues in the tourism industry that could be addressed in this report.

1. Lack of Personalization
2. Inefficient Resource Allocation
3. Lack of Real-time Information
4. Limited Customer Feedback Analysis
5. Sustainability and Responsible Tourism
6. Seasonal dependency
7. Security issues
8. Regulatory issues

2.0 ASSESMENT

2.1 Customer's needs assessment:

1. **Personalized travel recommendations:** Many tourists struggle to find personalized travel recommendations that match their unique preferences and interests. Traditional travel planning methods often provide generic suggestions, resulting in suboptimal experiences. There is a need for a solution that leverages data and technology to offer personalized recommendations for destinations, accommodations, attractions, and activities.

2. **Ease of communication:** One major challenge travellers face is the Language barrier. If the translation is not done efficiently, there could be misinterpretation, misinformation, and confusion. These negative effects can be worse than having access to translation.

3. **Access to Real-time Information:** Tourists often face challenges in accessing real-time information about destinations, local events, weather conditions, and transportation options. This lack of up-to-date information can lead to inconveniences, missed opportunities, and subpar travel experiences. Developing a solution that provides accurate, real-time information to tourists through mobile applications or other platforms can significantly enhance their travel experiences.

4. **Optimal Budget allocation:** Let's be honest in current times economy fluctuates a lot and facing fiscal challenges is quite common. Tourist often compromise with their travel experience because they don't understand how to allocate their budget smartly. Developing a Planner is needed so no-one has to compromise with their travel experience.

5. **Secure travel:** When we travel there can be many security or safety issues we can face such as Accidents, Baggage mishandling, Loss of travel documents etc. Developing a Solution to address this challenge is important to provide tourists sense of security in their adventures.

2.2 Market's/Business needs assessment:

1. **Target Market Identification:** Determining the demographics, psychographics, travel behaviours, and preferences of these market segments. This information helps in crafting targeted marketing campaigns and developing appropriate tourism products and services.

2. **Market Demand Analysis:** Assessing the demand for various tourism products and experiences in the target markets. Identifying popular travel themes such as adventure tourism, cultural tourism, eco-tourism, etc. Evaluating the current and projected market size, growth potential, and consumer spending patterns to understand the demand-supply dynamics.

3. **Customer Expectations and Preferences:** Analysing the preferences, expectations, and motivations of tourists within each market segment. Identify the factors that influence their travel decisions, such as price sensitivity, travel convenience, cultural immersion, sustainability, safety, and quality of experiences. This information helps in designing tourism offerings that align with customer preferences.

4. **Infrastructure and Service Assessment:** Assessing the existing tourism infrastructure, transportation facilities, accommodation options, and other supporting services in the target markets. Identifying gaps or deficiencies that may hinder the growth and development of the tourism industry. Consider factors such as accessibility, connectivity, availability of quality accommodations, and infrastructure for attractions and activities.

5. **Technology Adoption and Digital Trends:** Evaluate the level of technology adoption and digital maturity within the target markets. Assess the usage of online travel booking platforms, mobile applications, social media, and other digital channels. Identify trends and emerging technologies that can be leveraged to enhance the tourism experience and meet the evolving needs of tech-savvy travellers.

6. **Stakeholder Engagement:** Engage with key stakeholders in the tourism industry, including government bodies, tourism boards, industry associations, local communities, and businesses. Seek their insights, perspectives, and feedback on the existing challenges, opportunities, and

priorities for tourism development. Collaborate with stakeholders to ensure a holistic and inclusive approach to addressing market needs.

7. **Optimal Resource Allocation:** Tourism businesses often struggle with resource allocation, resulting in inefficiencies and suboptimal utilization of available resources. This includes challenges in managing inventory, pricing strategies, and staffing requirements. Developing intelligent systems using machine learning and optimization algorithms can help optimize resource allocation, improve revenue management, and enhance operational efficiency.

8. **Customer Feedback Analysis:** Analysing and extracting insights from the vast amount of customer feedback data using Natural language processing and sentiment analysis techniques can help tourism businesses gain valuable insights from customer feedback, enabling them to make data-driven decisions and improve service quality.

9. **Sustainable and Responsible Tourism:** With increasing concerns about sustainability and responsible tourism practices, the industry needs to address environmental, social, and cultural impact issues. Developing solutions that promote sustainable travel options, support local communities, and raise awareness about responsible tourism practices can contribute to a more sustainable and ethical tourism industry.

3.0 Customer Segments:

1. **Travel Bloggers:** Travel bloggers will be primary users for this App as they travel very frequently, they need access to lot of information for content creation and they need proper planning and budget allocation since it is a form of investment in their source of income

2. **Casual Tourists:** Tourists who are travelling casually have dire need of a translation service and proper accommodation.

3. **Insurance companies:** Travel insurance companies are secondary consumers who will leverage data generated from this App and strategize their policies and premium.

4. **Travel companies:** Travel companies can analyse data for forecasting demands and plan their prices accordingly.

4.0 Target Specification:

1. **Personalised Recommendation system:** By analyzing user preferences, historical data, and contextual information, machine learning models can suggest tailored travel destinations, Insurances, accommodations, attractions, Travel packages and activities to individual

travelers. This enhances customer satisfaction and engagement, leading to increased customer loyalty and repeat business.

2. **Computer Vision Based Real-time Infosystem:** Using Camera and Visual AI to recognise objects or buildings and access web to give brief descriptions and Fun-facts can enhance travelling experiences.

3. **Cloud based Photos/Videos Smart Backup:** When tourist visit some place they wish to secure all the memories and limited digital storage is a big obstacle. Also Distributing Group photos to each individual is also quite exhausting. This can be solved providing Smart back-up which stores Photos/Videos to cloud as soon as Fast Internet is available and integrated with Computer vision distributes photos to individuals by recognising there faces .

4. **NLP based Real-time translator:** To overcome Language barrier NLP based translator will recognise Language from user input speech and translate it to required Language. This can eliminate the need of paying for a human translator.

5. **Sentiment analysis of customer reviews and feedback:** This will provide valuable insights into customer perceptions and sentiment towards various tourism services and destinations. This information can be utilized by tourism businesses to improve service quality, identify areas of improvement, and effectively address customer concerns.

5.0   <u>External search:</u>

Machine Learning systems have several applications in tourism.

From the consumer perspective: ML equipes access to real-time and relevant information, and assist them in taking smart decisions.

From the Business/Market perspective: ML assists in driving targeted Marketing campaign, Identifying gap between demand and supply of Resources, Infrastructure requirements and local commute and many other aspects of Management specially in promotion and productivity. Machine learning also expected to encourage more sustainable travel by influencing customers to have a more social perspective.

Artificial intelligence systems in the tourism industry can be stand-alone systems or embedded in existing applications and systems. These systems include **Recommender systems, Personalization systems and techniques, Conversational systems** (chatbots and voice assistants), **Forecasting tools** (Flights fare and Hotel rates**), language translation applications**, and **smart tourism destinations**. Although we analyze each system separately, it must be stated that tourists will usually interact with technologies that integrate several of

these systems. For example, a guest may interact with a robot that integrates a conversational system, and, depending on the requirements, a recommender system, a personalization technique, or an autonomous agent. The dialogue with the user may be based on a chatbot or voice assistant.

6.0   Benchmarking:

The comparison table between services and product in Tourism with or without artificial intelligence.

	Service	Without ML	With ML
1.	Language translation	Need for a costly human translator, Miscommunications, Confusion	ML systems eliminate language barrier cost effectively
2.	Planning	Hard to pick appropriate activities, destinations etc from so many options	ML system takes your preferences as input and plans it for you
3.	Meeting demand	Hard to estimate quantity of tourists arrival so accomodation unavailability issue arises frequently	More accurate demand forecasting making stakeholders ready with adequate supply
4.	Promotion	More failed promotions	More successful promotions
5.	Budget factor	Incapability of tourists making budget decisions with hefty and complex costs	ML System assists in making smart decisions by easing down the calculations
6.	Secure travels	Tourists often has no idea or sufficient information to choose right travel insurance plans	ML system filters out irrelevant plans.
7.	Informative travel experiance	Need of a guide to tell tourists about destinations often he doesn't have sufficient knowledge	ML system identifies and provide real-time accurate knowledge

	8.	Responsible tourism	Lack of awareness about environmental and other regulations put tourists in problems	Tourists are more aware about these regulations

7.0 Applicable patents:

1. **China Pat no.** CN105550950A: **Location-based service travel recommendation method:-** The invention provides a location-based service travel recommendation method comprising the steps that step one, entity track-event information is acquired, and user-location-activity associated modeling is performed on the entity information through a three-dimensional tensor; step two, user track-event information is recorded; and step three, similarity matching is performed through user analogy, and the user track-event information with high similarity is actively pushed, wherein the user track-event information (from location information of mobile phones, sports bracelets and sports watches) is integrated and then matched with the related user track-event information, and pushing is performed.

2. **USA Pat no.** US5948040A : **Travel reservation information and planning system:** Computerized travel reservation information and planning system that generates "map ticket" output in various media, for guidance and transactions en route. Such print or electronic documents can include bar or alphanumeric codes for automated recognition and/or access. WHERE?, WHO/WHAT?, WHEN? and HOW? menus enable flexible user inquiries accessing selectable geographic, topical, temporal and transactional data records and relational processing. Sub-menus provide further capabilities: e.g. routing, topical searching; searches of events calendars, almanacs, appointment books, related itinerary scheduling; trip budgeting issues, plus travel arrangement availabilities or other goods/services offers.

8.0 Applicable Regulations:

1. E-transaction Law: Information Technology Act 2000
2. Data protection law: Bill - Personal Data Protection, 2019
3. Cybercrime Law: The Information Telecommunication Act of 2000, amended in 2008 - ITA

9.0 Applicable Constraints:

1. **Data availability and quality:** ML models require large volumes of high-quality data to learn and make accurately predictions. In the tourist industry, obtaining and processing such data can be challenging, especially for smaller businesses or regions with limited resources.

2. **Privacy and data protection:** The tourist industry often deals with sensitive customer data, including personal information and financial details. ML models must adhere to strict privacy regulations, such as GDPR (General Data Protection Regulation) in the European Union. Implementing appropriate security measures and ensuring data privacy can be a constraint when using ML in the industry.

3. **Interpretability and transparency:** Many ML models, such as deep neural networks, are often considered black boxes, making it difficult to interpret their decisions or predictions. In the tourist industry, where trust and transparency are crucial, it can be challenging to use ML models without providing clear explanations and justifications for their outcomes.

4. **Limited resources and expertise:** Implementing ML in the tourist industry may require significant computational resources, including powerful hardware and storage capabilities. Smaller businesses or organizations with limited budgets may find it challenging to invest in the necessary infrastructure. Additionally, there might be a shortage of ML expertise and skilled professionals within the industry.

5. **Ethical considerations:** ML models can inadvertently introduce biases or discrimination if the training data is not diverse or representative. In the tourist industry, where cultural diversity and inclusivity are essential, biases in ML models can have detrimental effects. Ensuring fairness and ethical use of ML algorithms is a constraint that needs to be carefully addressed.

6. **Dynamic nature of the industry:** The tourist industry is subject to rapid changes in customer preferences, market trends, and external factors (e.g., pandemics, natural disasters). ML models need to be adaptable and capable of handling these dynamic environments.

10.0 Business Opportunity:

AI driven Tourism industry has ample amount of business opportunities: -

1. **Subscription model:** App will work primarily as B2c brand providing AI based services of NLP based translation, Computer vision based real time Information, Listings off flights/buses to destination and accommodations at reduced costs and improved efficiency by providing more personalized recommendations for each customer and charge for subscriptions for these services.

2. **B2B with Service providers:** Hospitality organisations can utilize the model and gain Insights using Decision tree classification and regression to understand the consumer needs, Costs and calculate prospective growth opportunities and can be better equipped to service them by doing B2B business with our App.

3. **Advertisements:** Travel companies can also utilize decision tree model to find prospective clients and promote their packages on our platform by pushing Ads or getting their services reviewed and doing sentiment analysis on them.

11.0 Business Model:
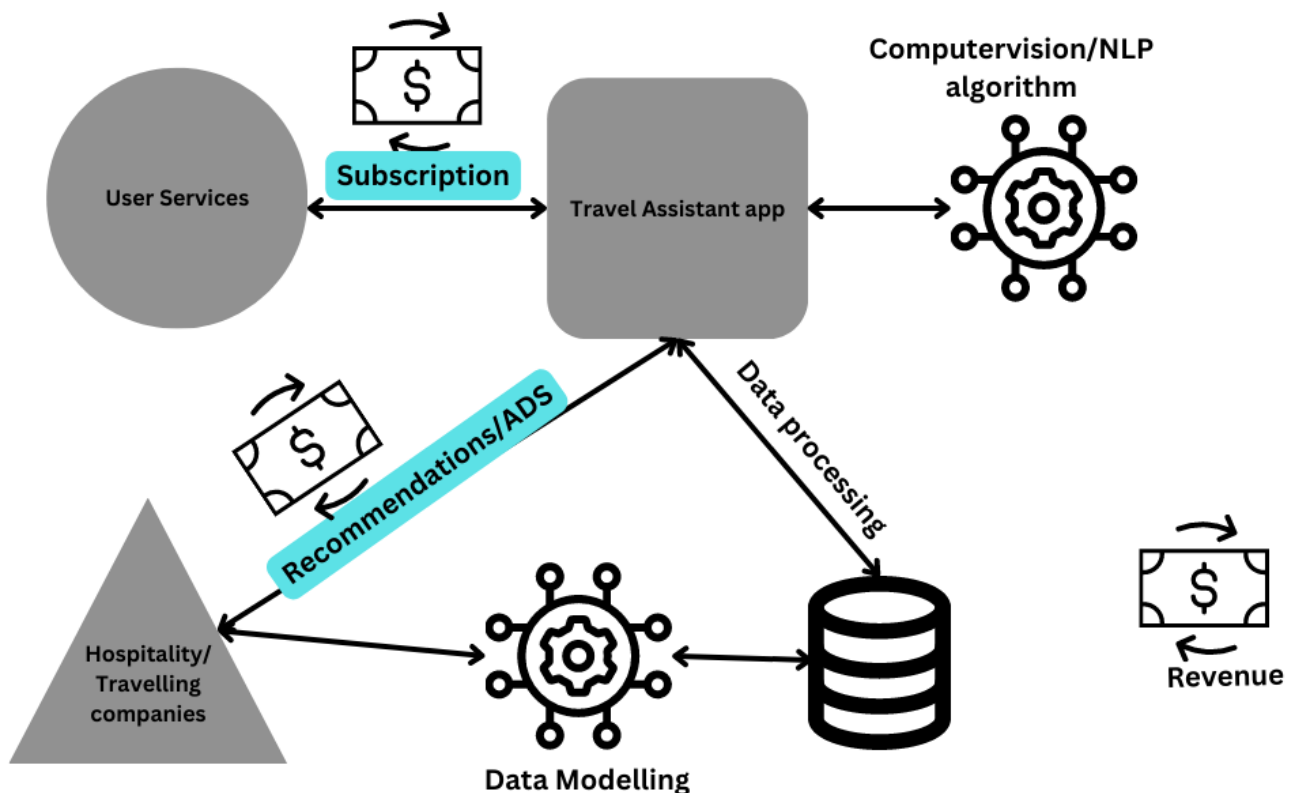
12.0 Data Collection and Processing:-

There are many kinds of labelled and unlabelled data needs to be collected.

1. **Personal information: -** These include Age, sex, Address, Relationship status etc. This category of data can help us understand demographics and Needs/Preference.
2. **Financial information: -** These might include credit score, income statements etc. This data helps us understand purchasing power and credit eligibility.
3. **Unlabelled data:** This data comes in form of text, photos, videos etc. These required for NLP, Sentiment analysis and Computer vision functions.

13.0 Final Product Prototype :
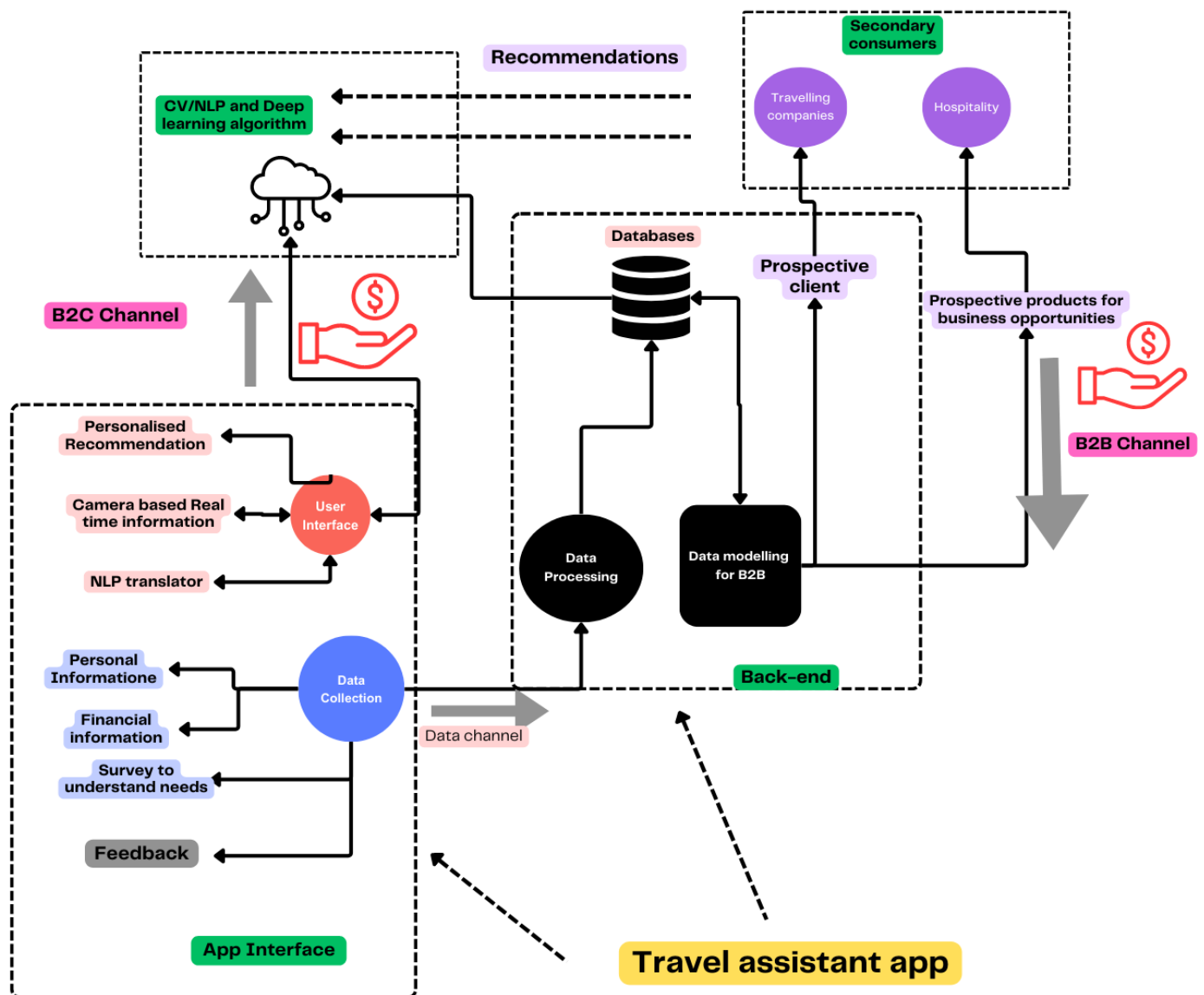
14.0 Product Details:-

14.1 Working Mechanism: -

At User End: -

1. It will primarily have 3 features for end Users: - Computer vision-based Media storage/distribution and Real time Information system, NLP based Voice translator, and Personalized recommendation system for Travelling packages Insurance, Destinations, Activities etc.

2. Data for Image processing will be collected via Camera, Voice data for NLP will be collected from Microphone and Data for recommendation system can be collected via Survey forms and Log-in Info.

At Back End: -

1. There will be two modules at back-end, and Data ETL pipeline to Database.

2. One module will support algorithms for Image information and Translator services and another module will model collected data to assist B2B business with Travel and Hospitality companies for Marketing and Recommendations functions.

14.2 Data Sources:

1. Labelled data from open-source Computer vision datasets. Examples**: - ImageNet, MS Coco, Flickr, Berkeley Deep Drive, MPII Human Pose etc.**

2. Labelled data from open-source NLP datasets. Examples :- **Kaggle, LibriSpeech, LJ Speech Dataset, Noisy Speech Database**

3. For Sentiment analysis **:- Sentiment 140, Yelp Reviews, Opin Rank Dataset**

4. Data From User Log-in info and financial statements.

5. Survey forms and Reviews.

14.3   Required Algorithms and Framework: -

1. **Object Detection and Image Segmentation Algorithms and Framework: -**

   - Scale-Invariant Feature Transform (SIFT)
   - Speeded Up Robust Features (SURF) algorithm is a feature detection and description method for images.
   - Eigenfaces to recognize faces in images. The algorithm is based on the concept of eigenvectors.
   - YOLO (You Only Look Once) is a state-of-the-art, real-time object detection system among the most widely used deep learning-based object detection methods.
   - Tensor-flow
   - SOD is an embedded, modern cross-platform computer vision and machine learning software library. It exposes a set of APIs for deep-learning, advanced media analysis, and processing, including real-time, multi-class object detection, and model training on embedded systems with limited computational resource and IoT devices.
   - OpenCV

2. **Natural Language processing Algorithms and Frameworks:**

   - Support Vector Machines.
   - Bayesian Networks.
   - Maximum Entropy.
   - Conditional Random Field.
   - Neural Networks/Deep Learning
   - PyTorch
   - Tensorflow

3. **Algorithms and Framework for Recommender system:**

   - Matrix Factorization
   - Collaborative Filtering
   - Reinforcement Learning
   - Apache Mahout
   - TensorFlow

- ApacheSpark
- Scikit-Learn

4. **Sentiment Analysis Algorithm and Framework:**

- Naïve Bayes
- Support Vector Machines
- Recurrent neural network
- Natural Language Toolkit
- Pytorch

14.4 Team Required:-

- Domain experts in Tourism and hospitality.
- Computer vision Engineer
- NLP Engineer
- Data Engineer
- Machine learning engineer
- MLops engineer

15.0 <u>Conclusion:</u>

In conclusion, the integration of machine learning-based solutions in the tourist industry will revolutionize the way travellers plan and experience their journeys. The combination of a personalized recommendation system, NLP translator, and image-based real-time information system will significantly enhance the overall travel experience.

The personalized recommendation system utilizes various travelling algorithms to provide tailored travel plans and Insurances based on user preferences, historical data, and contextual information. This empowers travellers to discover unique destinations, activities, and accommodations that align with their individual tastes and interests and assist them in smart decision making.

The NLP translator will bridge language barriers by leveraging natural language processing techniques. It enables seamless communication between travellers and locals, facilitating a deeper understanding of different cultures and enhancing interactions during the trip.

The image-based real-time information system will bring convenience and reliability to tourists, by analysing images, it can provide instant and accurate information about landmarks, attractions, and points of interest. This feature enables travellers to access relevant information in real-time, ensuring they make informed decisions and experience their surroundings to the fullest.

Collectively, these machine learning-based solutions will tackle some pretty big challenges in tourism by personalizing recommendations, breaking down language barriers, and providing on-the-go access to relevant information. They empower travellers to create memorable and customized experiences, fostering a deeper connection with their chosen destinations and enhancing overall satisfaction.

Referrals:

- Basiri A, Amirian P, Winstanley A, Moore T (2018) Making tourist guidance systems more intelligent, adaptive and personalised using crowd sourced movement data. J Ambient Intell Humaniz Comput 9(2):41 3–427
- Benckendorff PJ, Xiang Z, Sheldon PJ (2019) Tourism information technology. CABI, Boston
- Bowen J, Morosan C (2018) Beware hospitality industry: the robots are coming. Worldwide Hosp Tour Themes 10(6):726–733
- https://ourworldindata.org/grapher/international-tourist-arrivals
- https://globaledge.msu.edu/blog/post/55748/the-importance-of-tourism-on-economies-a
- https://www.altexsoft.com/blog/recommender-system-personalization/
- https://www.researchgate.net/publication/344729288_Machine_Learning_in_Tourism
- https://ideausher.com/blog/5-real-life-examples-of-ai-in-the-tourism-industry/#:~:text=to%20redeem%20themselves.-,Facial%20Recognition,examples%20of%20AI%20in%20tourism.