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INDIAN INSTITUTE OF INFORMATION TECHNOLOGY DHARWAD

Role of Artificial Intelligence in Microeconomics

MINI PROJECT REPORT

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May 09, 2022

PREFACE

The work presented in this project report is a result of our mini-project -1 work at the Indian Institute of Information Technology Dharwad. The research and experimentations were conducted between January 2022 to April 2022 under the guidance of Dr. Anushree Kini, Assistant Professor, Faculty in Humanities and Science@IIIT Dharwad, and Dr. Ramesh Athe, Assistant Professor, Data Science and Intelligent Systems@IIIT Dharwad.

Nowadays, we are using AI algorithms everywhere, so we choose this mini project, to study how AI algorithms are helping startups and new businesses to go big and provide better services and solutions to their customers. This report talks about our research work carried out on the topic "Role of Artificial Intelligence in Micro Economics". The scientific outcomes and understanding of the study are presented in nine different chapters.

Abhishek Singh Kushwaha Ashwin Mishra Sarang Vivek Dev

Dharwad, May 2022

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Our sincerest gratitude goes out to our advisors, Dr. Anushree Kini and Dr. Ramesh Athe, for allowing us to carry out this mini-project and for mentoring and advising us throughout this semester-long mini-project.

We would like to thank the whole department of Humanities and Science, and Data Science and Intelligent Systems at the Indian Institute of Information Technology Dharwad for providing me with an opportunity to work with them and contribute to their research and development.

We would also like to thank our families and friends for encouraging us and giving us moral and emotional support during the transition from online mode to offline mode.

Abhishek Singh Kushwaha Ashwin Mishra Sarang Vivek Dev

Dharwad, May 2022

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ABSTRACT

This report discusses the role of artificial intelligence algorithms in microeconomics and business and customers are benefiting from it. Since the early 2000s humanity has seen the rise and growth of artificial intelligence and its application in different sectors. A new application of AI is in the business and economics sector. Economics can be broadly divided into two fields first is microeconomics and the second is macroeconomic. For this mini-project, we have focused on microeconomics only. Further, we have concentrated on to Theory of Demand and Consumer Behaviour in different domains of microeconomics. In consumer behavior theory, we have focused on the different e-commerce websites and their problems faced by users.

Our problem statement is to study the consumer behavior on e-commerce platforms from an Indian perspective and a global perspective, and then Design and Implementation of a Real-Time Visual Search System for a faster and more efficient visual search process on E-commerce platforms. We also conducted a small survey on the same topic, to know the problems faced by Indian consumers on these platforms. We have asked these questions in the survey: • Which E-commerce platforms do you use? • Have you used the visual image search method while searching? • Was the visual image search method accurate enough? • Have you used 3D trial rooms? • Was the 3D trial room accurate and reliable?

In our two examples, we have discussed the problem faced by two companies first is Lenskart, an Indian company, which sells spectacles and eyeglasses, and the second is IKEA, a Swedish multinational conglomerate, which sells ready-to-assemble furniture, kitchen appliances, and home accessories. Both companies have their online e-commerce websites and both companies are heavily interested in image searches and optimizations for their e-commerce platforms. We have also discussed how these two companies are benefitting their own customers by using AI algorithms for their image searches.

In the Real-Time Visual Search System, we have suggested a system based on the current challenges faced by users. We have discussed the different aspects of the system and its design. How our proposed system is better than the previously existing systems and shows the results of the system's output and how this helps in better image searches. In the last section, we had shown the benefits and enhancements of using AI algorithms in the visual search systems of different e-commerce platforms. We have also discussed how it is leading to more and more customer satisfaction and more profit for the company.

HYPOTHESIS

Our project work revolves around the question "How artificial intelligence is changing the field of microeconomics, and how businesses and consumers are getting benefitted from this change?" We conducted our preliminary research on this question and get to know that there are different avenues of microeconomics, where artificial intelligence is used, further we concentrated on only one avenue i.e e-commerce websites and consumer behavior. To conduct our preliminary research, we have searched on the internet for different use cases, new algorithm designs to increase user experience, and ways to benefit the platform and customers.

According to the current scenario, a lot of artificial intelligence algorithms are used by the various e-commerce companies to provide better services to their customers, like voice-enabled searches, product recommendations based on past available data, correct price estimation, etc. In this project, we investigated in the current scenario how startups

and businesses are getting benefited from the upcoming technological revolutions like metaverse, augmented reality, etc. How these technologies are implemented in the current market, and how consumers are getting benefitted from this?

In our research, the independent variable is artificial intelligence algorithms and the dependent variable is microeconomics. According to our hypothesis, the relationship between artificial intelligence and microeconomics is a linear relation, which means when there is a boom in artificial intelligence, the impact of this boom will be linearly depicted on e-commerce and consumer behavior.

In our research and implementation, we found a lot of articles supporting our hypothesis. Some research papers we talking about how they have developed artificial intelligence algorithms specifically for e-commerce websites. We also went through a lot of market research reports and annual balance sheets of these companies citing how they have made huge margins by deploying these algorithms on their platforms.

Assumptions of our project:

- We have only considered those microeconomics areas, where there is plenty of research supporting the use of AI algorithms.
- We will not discuss the conflicting and controversial results of any experiments that we have come to know.
- In the project work, we only considered those AI algorithms with a decent history of their development and have matured over the years.
- We had tried our best to remove the biases from the survey, but it is not possible for us to remove them completely. So we are assuming that our survey result will have some biases in the end.

OBJECTIVE

To investigate and analyze the role of artificial intelligence in microeconomics. The past two decades were crucial in defining the shape of artificial intelligence, and now artificial intelligence is changing microeconomics and making it more automated and more accessible for the future. In this project, we investigated how microeconomics is changing from its past, and how it is giving benefits to our world.

For this, we have studied two examples, one from an Indian perspective and one from a global perspective. Apart from it we also had tried to implement an object detection algorithm to demonstrate how things work in an automated environment.

Three major objectives of our project are:

- One example study according to the Indian perspective
- One example study according to the global perspective
- Implementation of an object detection algorithm

Through these objectives, we have tried to show how businesses are getting benefitted from the artificial intelligence revolution, and also tried to understand how the consumers are getting benefits from this revolution.

There are other different attributes of artificial intelligence like habit prediction, speech recognition, etc. but these are out of our project scope and will not be focused on here. We will be achieving all of our project objectives by the end of April 2022.

METHODOLOGY

In this project, we have been using a lot of different research methods to get the data. We have mostly used two types of methods. The first one is qualitative and quantitative methods of data collection and the second method is primary and secondary methods of data collection. In the qualitative and quantitative methods, we collected a lot of data through the previous research works of researchers in this field, by investigating the business models and future plans of these platforms, reading annual reports on AI and the market direction of different consulting firms like Bain, McKinsey, and BCG. We have conducted a small survey by ourselves within our family and friend circles of ourselves. In the primary and secondary data collection methods, we have used the upcoming strategies of businesses regarding how to use the new technologies in their systems and how to benefit the customers from it.

During our research, the biggest obstacle we find is getting the correct data from the authenticated sources. In this IT era, there are plenty of ways to get information, but getting the correct information is becoming hard day by day. For getting the correct information, we have used the annual reports published by these e-commerce companies, different consulting firms, and different research papers from the educational institutions in India.

In our survey, there are some redundancies with the responses, but given the scenario of our survey, we have tried our best to collect only relevant information and manually remove false information. The sample size and time duration of our

survey were small in comparison to the standard norms.

We have analyzed the results that we have collected from the research papers and from our survey. We also have tried to implement a model to do the same as we have suggested in the project. All the objectives of the project have been met and the methodologies are found to be working fairly well. We have cited all the pre-existing resources that are used in this project at the end of the project report.

INTRODUCTION

1.1 Introduction

The world is changing rapidly. There is no time in history when virtually every aspect, whether human life, economies, or politics among other things, has been affected by the rapid change brought through by developments in information technology. Technological advances have allowed humanity to discover powerful energy sources, discover faster modes of transportation for humans, goods, and services, and improved the speed at which we communicate.

Technology has allowed human beings to have a better mode of diagnosing and even curing diseases. The speed at which the COVID-19 test was developed and deployed to deal with the pandemic that engulfed the globe in the first quarter of 2020 is testimony to this. In a sense, advances in technology have enabled humanity to conquer the barriers of nature. Life has certainly improved compared to our ancestors.

76%

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Economics, which has so far been resistant to the adoption of AI, is poised to undergo dramatic changes and thereby help humanity better solve its problems.

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Understanding how AI and machine learning are changing the field is essential to setting the right priorities and addressing existing issues

in economics.

Unlike any other subject,

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economics deals with people, their perceptions, and their irrationalities. A model that worked one day will not work the next time because of the rapidly changing moods of players.

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The implementation of AI and information technologies in general in economics, nevertheless, might change this situation for

the

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better. By modeling human behavior we can potentially estimate its impact on the real world. This will make it easier to identify financial bubbles and potential vulnerabilities in the economy, as well as to make better predictions. 1.2

Artificial Intelligence

Artificial Intelligence, is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.

Artificial intelligence is a constellation of many different technologies working together to enable machines to sense, comprehend, act, and learn with human-like levels of intelligence. Maybe that's why it seems as though everyone's definition of artificial intelligence is different: AI isn't just one thing. Technologies like machine learning and natural language processing are all part of the AI landscape. Each one is evolving along its own path and, when applied in combination with data, analytics, and automation, can help businesses achieve their goals, be it improving customer service or optimizing the supply chain.

1.3 Micro Economics

Microeconomics is the social science that studies the implications of incentives and decisions, specifically about how those affect the utilization and distribution of resources. Microeconomics shows how and why different goods have different values, how individuals and businesses conduct and benefit from efficient production and exchange, and how individuals best coordinate and cooperate with one another. Generally speaking, microeconomics provides a more complete and detailed understanding than macroeconomics.

Microeconomics studies the decisions of individuals and firms to allocate resources of production, exchange, and consumption. Microeconomics deals with prices and production in single markets and the interaction between different markets but leaves the study of economy-wide aggregates to macroeconomics. Macroeconomists formulate various types of models based on logic and observed human behavior and test the models against real-world observations.

NICHE SELECTION

2.1 Different Niches

Domains of Microeconomics where AI can be used:

- Consumer Demand Theory • Production Theory • Cost-of-Production Theory of Value • Opportunity Cost • Price Theory

2.2 Consumer Demand Theory

Consumer demand theory relates preferences for the consumption of both goods and services to the consumption expenditures; ultimately, this relationship between preferences and consumption expenditures is used to relate preferences to consumer demand curves. The link between personal preferences, consumption, and the demand curve is one of the most closely studied relations in economics. It is a way of analyzing how consumers may achieve equilibrium between preferences and expenditures by maximizing utility subject to consumer budget constraints.

2.3 Production Theory

Production theory is the study of production or the economic process of converting inputs into outputs. The production uses resources to create a good or service that is suitable for use, gift-giving in a gift economy, or exchange in a market economy. This can include manufacturing, storing, shipping, and packaging. Some economists define production broadly as all economic activity other than consumption. They see every commercial activity other than the final purchase as some form of production.

2.4 Cost-of-Production Theory of Value

The cost-of-production theory of value states that the price of an object or condition is determined by the sum of the cost of the resources that went into making it. The cost can comprise any of the factors of production and taxation. Technology can be viewed either as a form of fixed capital or circulating capital.

In the mathematical model for the cost of production, the short-run total cost is equal to fixed cost plus total variable cost. The fixed cost refers to the cost that is incurred regardless of how much the firm produces. The variable cost is a function of the quantity of an object being produced.

2.5 Opportunity Cost

Opportunity cost is closely related to the idea of time constraints. One can do only one thing at a time, which means that, inevitably, one is always giving up other things. The opportunity cost of any activity is the value of the next-best alternative thing one may have done instead. Opportunity cost depends only on the value of the next-best alternative. It doesn't matter whether one has five alternatives or 5,000.

Opportunity costs can tell when not to do something as well as when to do something. For example, one may like waffles but like chocolate even more. If someone offers only waffles, one would take it. But if offered waffles or chocolate, one would take the chocolate. The opportunity cost of eating waffles is sacrificing the chance to eat chocolate. Because the cost of not eating the chocolate is higher than the benefits of eating the waffles, it makes no sense to choose waffles. Of course, if one chooses chocolate, they are still faced with the opportunity cost of giving up having waffles. But one is willing to do that because the waffle's opportunity cost is lower than the benefits of the chocolate. Opportunity costs are unavoidable constraints on behavior because one has to decide what's best and give up the next-best alternative.

2.6 Price Theory

Price theory is a field of economics that uses the supply and demand framework to explain and predict human behavior. Price theory studies competitive equilibrium in markets to yield testable hypotheses that can be rejected.

Strategic behavior, such as the interactions among sellers in a market where they are few, is a significant part of microeconomics but is not emphasized in price theory. Price theorists focus on competition believing it to be a reasonable description of most markets that leaves room to study additional aspects of tastes and technology.

Price theory focuses on how agents respond to prices, but its framework can be applied to a wide variety of socioeconomic issues that might not seem to involve prices at first glance. Price theorists have influenced several other fields including developing public choice theory and law and economics. Price theory has been applied to issues previously thought of as outside the purview of economics such as criminal justice, marriage, and addiction.

Further concentrating on a particular domain of microeconomics, we choose consumer demand theory and consumer behavior, for our project work.

One of the main uses of AI is in cognitive sciences and psychology, in emotion, habit, and psychological thought prediction using previously available data. Consumer behavior also deals with the psychology of consumers and the microeconomics behind their behavior.

BACKGROUND

Online consumer behavior is the process of how consumers make decisions to purchase products in e-commerce. The behaviors themselves such as identifying a problem or deciding to make a purchase are based on ever-evolving expectations and needs. And while needs look different for every shopper, the new expectations that currently drive online consumer behavior are entrenched in commonality.

Technological advancements are creating new opportunities for people across a variety of industries, it improves quality cost-effectiveness, efficiency, and better consumer experience for customers. In providing these services AI is modifying the economics and also changing the environment to make maximum profit for the companies and provide a better service experience to the consumer. Due to technological advancements in AI e-commerce sites are maximum benefitted. AI gathers information about consumer choices, analyzes information, and recommends better products to the consumers. But the use of AI is not limited to collecting information, and history but also providing a better user experience to the customers with advancements in technology AI and machine learning algorithms such as facial recognition e-commerce sites are lacking in providing better solutions to customers taking an example of Amazon SEO which is only meant to sell their product if you want to search a product with specific quality and description it will be hard to find low priced product and with the same quality, some reviews on Play store by users say the worst customer experience and it is by the consumer who understands SEO.

Not Only the searching experience but also the fitting of wearables and products virtually in the photo is problematic to consumers according to tons of reviews from the product says that they got different products as compared to the photo on the website and the product size does not meet the standard.

With the advancement of technology, AI, and Machine learning, customers are not getting proper experience, resulting in a lack of trust in e-commerce sites and loss of revenue as they cannot retain their customers.

PROBLEM STATEMENT

Create a virtual platform where... • Users have an alternative to the weak SEO of E-commerce websites. • Users must be able to test the outfits in the virtual world, better than the present practices. (Most probably in Meta-verse.) • The required outfit should be searched on all the e-commerce platforms in 1 shot. • Users must be able to formulate the aspects of required outfits instead of available choices.

CASE 1: LENSKART'S EXPERIMENT WITH 3D TRIAL ROOMS

5.1 Introduction

In November 2010 Delhi based entrepreneur Peyush Goyal started Lenskart later two more co-founders joined him. It has a unique business model which provides an omnichannel model to customer's provide both online and offline experiences of shopping.

5.2 Growth and Features Introduced an eye check-up facility for the customers at their homes by a professional optometrist. They almost do more than 1500 check-ups per day for the customers. They also come with the creative and innovative idea of 3D face visuals that is when the customer is buying the eyewear only, they would be able to see themselves like how the frames are looking on them and these make the customers easy to select what they like.

5.3 Marketing Strategy and Business Model The concept of selling eyewear online is new in India and in the year 2011 it was risky too but with the best marketing strategy and business model, Lenskart proved it as a potential market

After running a campaign for the first frame free Lenskart made most of their first customer as loyal and potential ones, not only first frame free model the virtual try-on facility providing a frame to fit on the face made the customer feel that technology is reliable.

According to some stats, this marketing strategy made 50% of the conversion of customers for Lenskart.

5.4 App Features and Customer Retention With the unique idea of a 3D face trial and AR-based trial on the app.

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<https://indianonlineseller.com/2015/10/lenskar ...>

Lenskart has introduced a virtual trial room feature, where its potential buyers can try on the spectacles before they purchase them. Buyers can click a selfie through their webcam, and pick out glasses that best suit their face through a 3D feature. Lenskart is not the only online store that is giving its buyers the trial room option. Apparel stores are also exploring the option of providing their customers with a virtual trial room. With online shopping gaining prominence, a trial room option is a smart move.

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<https://indianonlineseller.com/2015/10/lenskar ...>

The entire exercise of enabling virtual fitting rooms is working out to be quite expensive, naturally. Lenskart's CEO, Peyush Bansal says, "We invested millions of dollars in getting this as close to reality as possible." 5.5

Lenskart And

Ditto Lenskart buys a minority stake of US-based 3-D modeling company Ditto For 1 million \$. After the announcement, Lenskart's CEO

98%

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<https://inc42.com/buzz/lenskart-ditto-3d-face- ...>

Said "Lenskart as a company has always believed in constantly innovating and leveraging the technology interface to give customers a best-in-class experience. Ditto provides us with the patented 3D virtual try-on technology that allows customers to see themselves in eyewear at 180° angles with realism. So far, the response to this service is commendable with over 10,000 trials every day. We have been evaluating our relationship and now want to take it to the next level. With this association, Ditto has now become a strategic partner for Lenskart and we certainly believe this will help us achieve a wider and more satisfied customer base." 5.6

Lenskart Financial and Revenue In the year 2021 Lenskart Collected over 855.20 crore INR in the year 2021 with the majority from online stores according to some data published by the company.

With expenses of 338 crore INR which is reduced from 363 from the year 2020 to 2021. Apart from that Lenskart buys a minimum share in U.S based start-up Ditto. The company claims 200% growth in each financial year

CASE 2: IKEA'S IKEA PALACE

An augmented reality app named, "IKEA PLACE" solves problems IKEA a multinational furniture company that originated in Sweden, launched related furniture selection and how it looks with a background of your home. In this section, we will discuss how IKEA is giving services to its customers and how business is changing due to this app.

6.1 Introduction

In today's era technology gives a boost to companies but at the same time technology provides better services to the customers. Technology offers promising ways to improve the shopping experience to prevent such unpleasant experiences. One such industry that can benefit from such improvement involves the services included in furniture retailing. In this article, IKEA Place App, by the renowned furniture retailer, is explored concerning its service innovation to offer its customers an outstanding digital experience in their shopping. Ikea was first introduced first to resemble furniture now they used the AR technique to provide a better consumer experience to their customers.

6.2 IKEA App

IKEA, a worldwide known furniture company, has tapped into opportunities engaged in new technology for delivering better service. The company, launched back in 1943, grew into a world giant. Although it is the best renowned Scandinavian furniture company, the services that IKEA design offers to its customers also constitute a significant component of its marketing activities. Along these lines, in September 2017, the company launched an AR app, namely, IKEA Place, that aims to solve practical problems surrounding furniture shopping. With the aid of the freely downloadable app, customers would be allowed to try out furniture in their homes before buying it. The app would use AR to allow its users to visualize how furniture will look in their own homes. Not only would it take the hassle of furniture shopping off, but it would also eliminate the burden of returning any furniture that does not fit. With this free app, IKEA creates a service-centered value as it signals that it understands the hurdles involved in the furniture shopping process and extends support. IKEA Place App provides means for customers not only to decide which furniture to buy but saves them from undesirable unfit results. For this aim, the app enables furniture shoppers to virtually furnish their rooms with some 2,000 objects and accessories available from the IKEA catalog. It is as easy as snapping the space and then selecting the item. The app automatically scales the chosen product to the size based on the shopper's room's dimensions with some 98% accuracy. Furthermore, the ability to see the texture of the fabric and how it will look in your home. This app also saves time to visit the offline store and improves consumer behavior by providing better S.E.O to the consumers.

6.3 Financial and Business Model Of IKEA

Despite an overall decrease in sales of all other e-commerce in the year 2019 IKEA's online sales rose by 50% Barbara Martin Coppola, IKEA Group's Chief Digital Officer told in an interview about her total growth in sales. "It's a huge revamp with a lot of ambition and dreams to get the values and feeling of Ikea to be solved in a digital way. And to also create this, what I call the 'phygital' new world, so you've got physical and digital ... and to be creating really magical new experiences," she said in an interview with CNBC. "It's (about) thinking, what is that new retail world going to be?" said Martin Coppola of IKEA's e-commerce developments. Adding, "So, there is an interesting movement of tech companies becoming physical and physical companies going digital. And that intersection, that 'phygital' world is still to be defined." While Ikea's market covers a total of 45.8 Bn \$ dollars while online sales only contribute 10% of total sales but due to innovation in its technology Ikea's online sales increased by 50% in a year.

6.4 Challenge and Solution Earlier people got frustrated by selecting furniture it will suit their home or not but IKEA provided, a well-optimized IKEA Place that should make the furniture visualization intuitive, effective and fun, ultimately boosting IKEA's online sales.

6.5 Working Model of the IKEA App

6.6 Some Reviews by Customers on App Stores are "It's always scary to pick out a couch or a chair without knowing what it might look like in your home rather than the showroom floor," said Wilson (2019). "Now, technology has caught up with our ambition. AR lets us redefine the experience for furniture retail once more, in our restless quest to create a better everyday life for everyone, everywhere" (Chang, 2018)".

Google search trend after the launch of the app.

SURVEY

7.1 Introduction

Survey was conducted to understand people's inclination toward various E-commerce websites as per their user experience. Voters were asked about their usage of visual image search options on these websites. Voters who have used such an option were asked about its reliability and accuracy. People were also asked about their usage of 3D trial rooms and their accuracy.

7.2 Survey Questions

Questions asked in the survey:

1. Which E-commerce platforms do you use?
2. Have you used the visual image search method while searching?
3. Was the visual image search method accurate enough?
4. Have you used 3D trial rooms?
5. Was the 3D trial room accurate and reliable?

7.3 Results

7.4 Cronbach's Alpha Reliability Coefficient of our Survey Cronbach's alpha is a measure used to assess the reliability, or internal consistency, of a set of scale or test items. In other words, the reliability of any given measurement refers to the extent to which it is a consistent measure of a concept, and Cronbach's alpha is one way of measuring the strength of that consistency.

Cronbach's alpha is computed by correlating the score for each scale item with the total score for each observation (usually individual survey respondents or test takers), and then comparing that to the variance for all individual item scores:

Alternatively, Cronbach's alpha can also be defined as

Significance of Cronbach's Alpha: Cronbach's Alpha is used to check the internal consistency and reliability of the survey.

Cronbach's Alpha

Internal Consistency ≥ 0.9 Excellent $0.9 < \geq 0.8$ Good $0.8 < \geq 0.7$ Acceptable $0.7 < \geq 0.6$ Questionable $0.6 < \geq 0.5$ Poor $0.5 < \text{Unacceptable}$

We have calculated the Cronbach's Alpha Reliability Coefficient for our survey using the above mention formulas, and our Cronbach's alpha is 0.73. According to the above table, our lies between 0.8 to 0.7, which interprets that our survey is acceptable. The results of our survey can be used as a standard result. 7.5 Limitations

Limitations of our survey are as follows:

- There is always a risk that respondents have provided dishonest answers.
- We might discover that some questions don't get answers.
- There can be differences in how people understood our survey questions.
- Surveys struggle to convey emotions with the achievable results. Some answers can be challenging to classify.
- We must remove someone with a hidden agenda as soon as possible. Surveys don't provide the same level of personalization.
- Some respondents will choose answers before reading the questions.
- Accessibility issues can impact some surveys.
- Survey fatigue and lack of time can be real issues that some respondents face.
- The lack of time to carry out a survey.
- Our survey sample is within our friend and relative circles, so we have used a small group for the survey.
- We conducted our survey only for 24 hours, so we also have less time for the survey.

SYSTEM DESIGN

8.1 Introduction

Visual search or image content-based retrieval is a very active area driven by the rapid progress of deep natural network technology for image recognition. It is particularly useful for both online and in-store shopping for it can greatly improve customers' experience and engagement. Although significant progress has been made, such as Google Similar Images and Amazon Flows for Internet search, and Pinterest Lens and Google Lens for similar product search, building end-to-

end Internet-scale visual search systems for retailing services is still a very challenging task. Hence we have made a new algorithm based on the following dimensions:

1. We design and implement a distributed hierarchical system that provides scalable image feature extraction, indexing, and retrieval for very large-scale image-content-based search in real-time. 2. We propose a high-performance real-time image indexing method that utilizes various optimization techniques to support sub-second image update and retrieval. 3. We evaluate the performance of the proposed visual search system on amazon.com

8.2 Challenges

1. The product image collection on e-commerce sites is rapidly and continuously growing. The visual search system must be able to handle a very large volume of images in a scalable way.

2. As products are updated very frequently on e-commerce sites, the associated image collection needs to be updated accordingly in a timely and effective matter. 3. E-commerce visual search has a much more stringent requirement on real-time and consistency.

8.3 Methodology

- The indexing sub-system is the core of our visual search system. It extracts image features and builds indexes for image search. To ensure data completeness and freshness, both periodic full indexing and real-time incremental indexing are performed. The full indexing periodically builds indexes for all the images. The real-time indexing is immediately triggered upon receiving a product update event such as the addition, deletion, and modification of a product. Real-time indexing is very critical for a good user experience by making sure the search results reflect the most recent product information at the time of reporting.

- To search a picture, an item in the picture is detected and the product category of the item is identified. The high dimensional features of the item's image are extracted. The most similar items (e.g., top k) are identified by traversing the inverted lists. • If the cluster is not getting identified by any of the brokers, the individual evaluation will be done image by image. (Rare scenario)

8.4 Pictorial representation of system design

8.5 Results

We demonstrate how to design and implement a real-time visual search system on Amazon's Internet-scale e-commerce site through distributed architecture and efficient indexing. We plan on integrating advanced search and ranking algorithms into our visual search system in the future.

CONCLUSION

This mini-project has shown us the different ways artificial intelligence algorithms have been used in different applications of business and economics. In our mini-project, we investigated the role of AI in microeconomics we particularly focused on the consumer behavior theory of microeconomics. As we know that with the right data AI algorithms can predict the upcoming behavior or pattern of the underlying data. This concept will be used by AI algorithms to predict future consumer behavior based on their past data. Now, coming to the background of our topic, we have analyzed a lot of different aspects of different e-commerce platforms like image searches, voice searches, text searches, actual size mismatch, customer experience, and reviews. We came to the conclusion that image searches are the worst in all of them and poorly performed by most of the platforms. With the increase of automated searches, many times images captured by live cameras are used to do image searches and this will result in poor image search performance. So we decided to target improving the image search performance of e-commerce websites.

Our problem statement focuses on

Creating/suggesting a virtual platform where... • Users have an alternative to the weak SEO of E-commerce websites. • Users must be able to test the outfits in the virtual world, better than the present practices. (Most probably in Meta-verse.) • The required outfit should be searched on all the e-commerce platforms in 1 shot. • Users must be able to formulate the aspects of required outfits instead of available choices.

To check the relevance of our selected problem, we have conducted a small survey in the circle of our peers, friends, and relatives. The results of the survey are as follows: • Amazon, Flipkart, Myntra, and LensKart are the most used e-commerce platform among them. • 70% of people use the image search option while searching on these e-commerce platforms. •

60% of people say that the image search option is not accurate enough. • 67% of people have used this new technology called 3D trial room by LensKart. • 67% of people have admitted that 3D trial rooms are not helping customers to choose their eyewear. Although there are some limitations to our survey like we have used a small group of people to do the survey. There is always a risk that respondents have provided dishonest answers. Some respondents will choose answers before reading the questions. Despite all of this we have used Cronbach's Alpha Reliability Coefficient to check the reliability of our survey, and we found that the Cronbach's Alpha Reliability Coefficient of our survey is 0.73, which interprets that our survey is acceptable. The results of our survey can be used as a standard result.

To understand the scenario in a better way we have also studied two examples of how an Indian company LensKart and an MNC IKEA is using these technologies to provide a better customer experience. LensKart was the first one to introduce the 3D face trial for selecting the correct eyewear for their customers. The idea of 3D face visuals that is when the customer is buying the eyewear only, they would be able to see themselves like how the frames are looking on them and this makes the customers easy to select what they like.

100%

MATCHING BLOCK 8/15

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<https://indianonlineseller.com/2015/10/lenskar ...>

Buyers can click a selfie through their webcam, and pick out glasses that best suit their face through a 3D feature.

The concept of selling eyewear online is new in India and in the year 2011 it was risky too but with the best marketing strategy and business model, Lenskart proved it as a potential market. Lenskart collected over 855.20 crore INR in the year 2021 with the majority from online stores according to some data published by the company. According to Indianstats.com, this marketing strategy made 36% of the conversion of customers for Lenskart.

IKEA followed the same strategy as Lenskart, they launched an app called IKEA PLACE. It allows the customers to try out furniture in their homes before buying it. The app would use AR to allow its users to visualize how furniture will look in their own homes. Not only would it take the hassle of furniture shopping off, but it would also eliminate the burden of returning any furniture that does not fit. Despite an overall decrease in sales of all other e-commerce in the year, 2019 IKEA's online sales rose by 41% (Ikea annual report 2019-20). Ikea place app was given credit to increase the traffic on the website and make the brand a common discussion topic. Ikea place app users have increased by 12% in 2019-2020 signifying the pandemic effects.

In the last section, we have suggested a system that can be used to improve the visual searches and improve these image search performances. The technical challenges faced by these image search systems are:

- The product image collection on e-commerce sites is rapidly and continuously growing. The visual search system must be able to handle a very large volume of images in a scalable way.
- As products are updated very frequently on e-commerce sites, the associated image collection needs to be updated accordingly in a timely and effective manner.
- E-commerce visual search has a much more stringent requirement on real-time and consistency.

Our System Architecture is as follows:

Our proposed system can support real-time visual search with hundreds of billions of product images at sub-second timescales and handle frequent image updates through distributed hierarchical architecture and efficient indexing methods. We also demonstrate how to design and implement a real-time visual search system on Amazon's Internet-scale e-commerce site through distributed architecture and efficient indexing. We plan on integrating advanced search and ranking algorithms into our visual search system in the future.

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84%

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89%

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84%

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Hit and source - focused comparison, Side by Side

Submitted text As student entered the text in the submitted document.
Matching text As the text appears in the source.

1/15	SUBMITTED TEXT	27 WORDS	76% MATCHING TEXT	27 WORDS
	Economics, which has so far been resistant to the adoption of AI, is poised to undergo dramatic changes and thereby help humanity better solve its problems.		Economics, which has so far been resistant to the adoption of AI, is poised to undergo dramatic upheavals — arguably the greatest changes since Adam Smith's inception of the science — and thereby help humanity better solve its problems.	
	W https://towardsdatascience.com/how-ai-will-redefine-economics-ec305e3cb687			

5/15	SUBMITTED TEXT	22 WORDS	100% MATCHING TEXT	22 WORDS
	Understanding how AI and machine learning are changing the field is essential to setting the right priorities and addressing existing issues		Understanding how AI and machine learning are changing the field is essential to setting the right priorities and addressing existing issues	
	W https://towardsdatascience.com/how-ai-will-redefine-economics-ec305e3cb687			

2/15	SUBMITTED TEXT	30 WORDS	94% MATCHING TEXT	30 WORDS
	economics deals with people, their perceptions, and their irrationalities. A model that worked one day will not work the next time because of the rapidly changing moods of players.		economics deals with people, their perceptions and irrationalities. A model that worked one day will not work the next time because of the rapidly changing moods of players.	
	W https://towardsdatascience.com/how-ai-will-redefine-economics-ec305e3cb687			

3/15	SUBMITTED TEXT	18 WORDS	100% MATCHING TEXT	18 WORDS
	The implementation of AI and information technologies in general in economics, nevertheless, might change this situation for		The implementation of AI and information technologies in general in economics, nevertheless, might change this situation for	
	W https://towardsdatascience.com/how-ai-will-redefine-economics-ec305e3cb687			

4/15	SUBMITTED TEXT	38 WORDS	100% MATCHING TEXT	38 WORDS
	<p>better. By modeling human behavior we can potentially estimate its impact on the real world. This will make it easier to identify financial bubbles and potential vulnerabilities in the economy, as well as to make better predictions. 1.2</p> <p>W https://towardsdatascience.com/how-ai-will-redefine-economics-ec305e3cb687</p>		<p>better. By modeling human behavior we can potentially estimate its impact on the real world. This will make it easier to identify financial bubbles and potential vulnerabilities in the economy, as well as to make better predictions.</p>	

6/15	SUBMITTED TEXT	86 WORDS	98% MATCHING TEXT	86 WORDS
	<p>Lenskart has introduced a virtual trial room feature, where its potential buyers can try on the spectacles before they purchase them. Buyers can click a selfie through their webcam, and pick out glasses that best suit their face through a 3D feature. Lenskart is not the only online store that is giving its buyers the trial room option. Apparel stores are also exploring the option of providing their customers with a virtual trial room. With online shopping gaining prominence, a trial room option is a smart move.</p> <p>W https://indianonlineseller.com/2015/10/lenskart-launches-online-trial-room-feature-to-enhance-cus ...</p>		<p>Lenskart has introduced a virtual trial room feature, where its potential buyers can try on the spectacles before they purchase them. Buyers can click a selfie through their webcam, and pick out glasses that best suit their face through a 3D feature. Lenskart is not the only online store that is giving its buyers the trial room option. Apparel stores are also exploring the option of providing its customers with a virtual trial room. With online shopping gaining prominence, a trial room option is a smart move.</p>	

7/15	SUBMITTED TEXT	36 WORDS	100% MATCHING TEXT	36 WORDS
	<p>The entire exercise of enabling virtual fitting rooms is working out to be quite expensive, naturally. Lenskart's CEO, Peyush Bansal says, "We invested millions of dollars in getting this as close to reality as possible." 5.5</p> <p>W https://indianonlineseller.com/2015/10/lenskart-launches-online-trial-room-feature-to-enhance-cus ...</p>		<p>The entire exercise of enabling virtual fitting rooms is working out to be quite expensive, naturally. Lenskart's CEO, Peyush Bansal says, "We invested millions of dollars in getting this as close to reality as possible."</p>	

9/15	SUBMITTED TEXT	106 WORDS	98% MATCHING TEXT	106 WORDS
	<p>Said "Lenskart as a company has always believed in constantly innovating and leveraging the technology interface to give customers a best-in-class experience. Ditto provides us with the patented 3D virtual try-on technology that allows customers to see themselves in eyewear at 180° angles with realism. So far, the response to this service is commendable with over 10,000 trials every day. We have been evaluating our relationship and now want to take it to the next level. With this association, Ditto has now become a strategic partner for Lenskart and we certainly believe this will help us achieve a wider and more satisfied customer base." 5.6</p>		<p>said "Lenskart as a company has always believed in constantly innovating and leveraging the technology interface to give customers a best in class experience. Ditto provides us with the patented 3D virtual try-on technology that allows customers to see themselves in eyewear in 180° angles with realism. So far, the response to this service is commendable with over 10,000 trials every day. We have been evaluating our relationship and now want to take it to the next level. With this association, Ditto has now become a strategic partner for Lenskart and we certainly believe this will help us achieve a wider and more satisfied customer base."</p>	
	<p>W https://inc42.com/buzz/lenskart-ditto-3d-face-modelling/</p>			

8/15	SUBMITTED TEXT	22 WORDS	100% MATCHING TEXT	22 WORDS
	Buyers can click a selfie through their webcam, and pick out glasses that best suit their face through a 3D feature.		Buyers can click a selfie through their webcam, and pick out glasses that best suit their face through a 3D feature.	
	<div>W</div> https://indianonlineseller.com/2015/10/lenskart-launches-online-trial-room-feature-to-enhance-cus ...			

10/15	SUBMITTED TEXT	22 WORDS	92% MATCHING TEXT	22 WORDS
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W	https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_64730 ...			

11/15	SUBMITTED TEXT	16 WORDS	100% MATCHING TEXT	16 WORDS
	Anagaha Ramesh, Ankit Raj Kushal, Brinda D, Vaishnavi S, Purohit Srinivasacharya. 3D Virtual Trial Room,		Anagaha Ramesh, Ankit Raj Kushal, Brinda D, Vaishnavi S, Purohit Srinivasacharya, 2018, 3D Virtual Trial Room,	
	<div><div>W</div><div>https://www.ijert.org/3d-virtual-trial-room</div></div>			

12/15	SUBMITTED TEXT	15 WORDS	89% MATCHING TEXT	15 WORDS
	Proceedings of the 21st ACM SIGKDD International Conference on Knowledge Discovery and Data Mining.		Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, 2015-	
	W https://link.springer.com/article/10.1007/s12525-022-00537-z			

13/15	SUBMITTED TEXT	15 WORDS	84% MATCHING TEXT	15 WORDS
	Proceedings of the 24th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining.		Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, 2015-	
	W https://link.springer.com/article/10.1007/s12525-022-00537-z			

15/15	SUBMITTED TEXT	15 WORDS	89% MATCHING TEXT	15 WORDS
	Proceedings of the 23rd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining.		Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, 2015-	
	W https://link.springer.com/article/10.1007/s12525-022-00537-z			

14/15	SUBMITTED TEXT	15 WORDS	84% MATCHING TEXT	15 WORDS
	Proceedings of the 24th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining.		Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, 2015-	
	W https://link.springer.com/article/10.1007/s12525-022-00537-z			