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Empowering the Unbanked: A Revolution in Financial Inclusion through Artificial Intelligence

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***Abstract*: Financial institutions have been ambivalent with their approach towards adopting artificial intelligence (AI), following its rise in the 2010s. However, there are various areas where artificial intelligence could be applied in the finance industry which can reduce the problems faced by the unbanked and underbanked population. Furthermore, this paper specifically focuses on the application of Artificial Intelligence towards achieving financial inclusion for the unbanked and underbanked population. There are various challenges such as no credit history, lack of access to credit, lack of access to financial services and lack of personalized financial services. The paper seeks to address the problem and propose the solution for the same with the help of Artificial intelligence. First, the many components of the technology—including its background, operation, traits, SWOT analysis, and broad applications—are discussed. Secondly, the various efforts and initiatives by the different financial institutions and tech companies. Further, an overall overview on the Finance Industry is analyzed, wherein the structure and drawbacks of the existing system is elaborated. In the last section, an artificial intelligence-based solution has been proposed to solve the problems of the unbanked and underbanked population. Therefore, a strategic solution to an evident problem has been conveyed through this research and it poses a practical significance.**

***Keywords*: Artificial Intelligence, financial inclusion, unbanked population, underbanked population.**

1. Introduction

In an increasingly interconnected and digital world, access to financial services is frequently regarded as a fundamental right, providing individuals with the tools and opportunities to enhance their economic well-being. Nevertheless, a substantial portion of the world's population continues to be shut out of the formal financial system, a discrepancy that perpetuates poverty, restricts economic expansion, and enlarges societal inequalities. The unbanked and underbanked individuals, often marginalized and underserved, encounter various barriers in their pursuit of becoming a part of the financial mainstream, including limited access to traditional banking infrastructure, difficulties with identity verification, and geographical isolation. Governments, financial institutions, and innovators are seeking innovative solutions to bring the unbanked population into the mainstream. One such transformative force on the horizon is Artificial Intelligence (AI). AI, with its capacity for automation, data analysis, and smart decision-making, has the potential to completely transform the financial sector by expanding its reach to previously underserved groups. The integration of AI-driven technologies into financial services holds the possibility of removing long standing barriers to financial inclusion, offering specialized solutions that address the unique requirements and circumstances of the unbanked. This research paper explores the dynamic intersection of AI and financial inclusion, shedding light on the possibilities, challenges, and implications of harnessing AI to empower the unbanked population. The world is experiencing an AI renaissance, with applications permeating various facets of our lives, from healthcare to transportation, and finance is no exception. Financial institutions are rapidly turning to AI to improve customer experiences, automate processes and cut costs.

2. Artificial Intelligence Technology

A. Understanding Artificial Intelligence

In order to effectively understand the use case and application of artificial intelligence in financial inclusion, it becomes crucial to understand the history, functions, working, and the SWOT analysis of the technology. Artificial Intelligence (AI) is a term that has captured the imagination of scientists, engineers, and the general public alike for decades. It has been the subject of countless books, movies, and debates, often portrayed as both a harbinger of promise and a source of concern. Fundamentally, artificial intelligence (AI) is the development of computer systems that are capable of performing tasks that previously required human intelligence. These tasks encompass a wide spectrum, from solving complex mathematical problems and recognizing patterns in data to natural language understanding and even decision-making. AI is a multidisciplinary field that draws from computer science, mathematics, neuroscience, and various other domains to replicate and sometimes enhance human cognitive abilities in machines. Artificially intelligent systems have a tendency to be capable of performing tasks that are frequently linked with human cognitive abilities, such as interpreting speech, playing games, and recognizing patterns. They frequently cultivate this

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ability by filtering through enormous amounts of data in search of patterns that they can then employ to inform their own assessment. Humans will frequently monitor an AI's learning process, encouraging wise choices and condemning ineffective ones. However, some AI systems are built to learn on their own, for instance by repeatedly playing a video game until they understand the rules and how to win. AI has the ability to acquire and use knowledge (American Heritage Dictionary, 2000), it has the ability to learn, understand and make judgments or have opinions that are based on reason (Cambridge Advance Learner's Dictionary, 2006), and it has the capability to learn facts and skills and apply them (Encarta World English Dictionary, 2006).

B. History of Artificial Intelligence

Going back to previous events in Milat is needed to gain knowledge about the history of artificial intelligence. It is acknowledged that numerous concepts for humanoid robots were implemented throughout the Ancient Greek era. An example of this is Daedalus, who is said to have ruled the mythology of the wind, to try to create artificial humans. The objective of defining philosophers' frameworks of human consciousness has begun to be recognized throughout history via the development of modern artificial intelligence. Vannevar Bush's seminal work "As We May Think" (Bush, 1945) proposed a system which amplifies people's own knowledge and understanding. Five years later, Alan Turing published a paper on the theory that computers could mimic human behavior and be sufficiently advanced to play games. (Turing, 1950).

Alan Turing, an English mathematician, released a paper titled "Computing Machinery and Intelligence" in 1950, which paved the way for the development of artificial intelligence. Years had passed before the phrase "artificial intelligence," as coined by John McCarthy, became widely accepted. Claude Shannon proposed that computers could play chess in 1950. In the logic theorist, Newell and colleagues demonstrated what is perhaps the first AI programmed to imitate human problem-solving (Newell & Simon, 1956). Even though the conference allegedly didn't live up to expectations, it made the case that AI was possible if every component of learning and intelligence could be explained with sufficient detail that a machine could imitate it (Moor, 2006). 1884 is very important for artificial intelligence. On this day in history, Charles Babbage began working on a mechanical device that will display intelligent behavior. However, as a result of these studies, he decides that he would not be able to produce a machine that would exhibit as intelligent behaviors as a human being, and he took his work suspended.

Up until the early 1960s, artificial intelligence research was made slowly. Officially speaking, artificial intelligence first appeared in history in 1956. During this time, the first applications of artificial intelligence were released. These programmers are built on chess and logic theorems. The first two decades of the twenty-first century saw a significant increase in investment in AI due to the availability of enormous data sets, powerful computing devices, and innovative techniques. Due of this, machine learning has been used to a wide range of issues in both academia and industry (Frank 2019; Hassani et al. 2020). AI has changed from being a purely academic discipline in this century to playing a significant role in social and economic mainstream technologies such as banking, medical diagnostics, driverless vehicles, and voice-activated help. (Frank 2019).

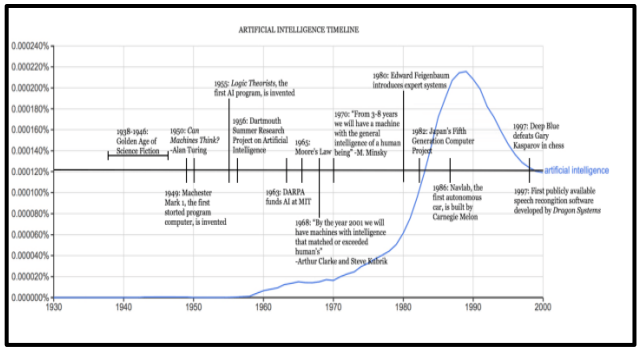

Fig. 1. History of AI
Image Source:
https://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/

C. Working of Artificial Intelligence

Simply put, AI operates through integrating substantial data sources with algorithms for perceptual processing. By identifying trends in the data's behavior, AI can change these algorithms. It's fundamental to know that AI does not comprise a single algorithm. Instead, it is an entire machine learning system that has the ability to solve issues and make recommendations. The first step of AI is input. The data essential for AI to operate properly must be accumulated by an engineer in this step. Data inputs do not necessarily have to be text; they can also be audio or visual. It's essential to make sure the algorithms can read the data inputted. It's vital to describe the significance of the data and the anticipated outcomes in this stage as well. AI makes decisions regarding how to utilize data as it analyses it. Depending on the specific AI technology, AI assesses the already programmed data and utilizes the behaviors it acquired to determine identical or equivalent behavior patterns in real-time data.

In many AI applications, especially those involving complex data like images, text, and speech, neural networks are used. These networks are made up of layered stacks of artificial neurons that are connected. Deep learning, a subset of machine learning, relies heavily on neural networks and has achieved significant breakthroughs in AI tasks. During the training phase, AI models are exposed to the data, and they iteratively adjust their internal parameters to minimize errors and improve their performance on the given task. This process continues until the model achieves a satisfactory level of accuracy. Once trained, AI models can make predictions, classifications, or decisions on new, unseen data. This phase is known as inference and is where AI systems demonstrate their intelligence by applying what they've learned. Many AI systems are designed for continuous learning, allowing them to adapt and improve over time. This is crucial for keeping AI models up-to-date and relevant in dynamic environments. In

some AI applications, a feedback loop is established where the AI system receives feedback from its actions, either from users or from the environment, and uses this feedback to refine its performance. AI models are deployed in real-world applications to automate tasks, assist decision-making, or enhance human capabilities. They can be embedded in software, devices, or cloud-based services.

It's important to note that AI is a broad field, and the specific workings of AI systems can vary significantly based on the application and the underlying algorithms used. Additionally, AI continues to evolve rapidly, with ongoing research and development pushing the boundaries of what AI systems can achieve.

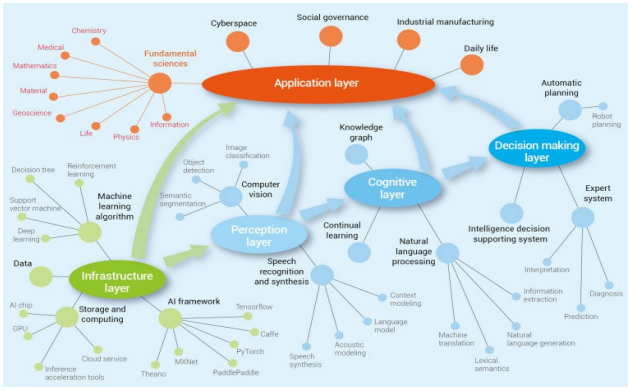

Fig. 2. Working of AI

Image source: Artificial intelligence: A powerful paradigm for scientific research 2021

Subfields of Artificial Intelligence:

1) Machine Learning

Machine Learning (ML) is a subset of artificial intelligence that empowers computers to learn patterns and make decisions from data without explicit programming. It revolves around algorithms that iteratively analyze data, refine models, and improve their performance over time. Divided into supervised, unsupervised, and reinforcement learning, ML is integral in diverse applications, from predicting outcomes and recognizing patterns to natural language processing. Its versatility enables automation, personalized recommendations, and the development of sophisticated systems, making it a transformative force across industries, constantly evolving with new advancements in algorithms and computing power.

2) Computer Vision

It is now achievable for robots to interpret and comprehend visual data from the outside environment thanks to the interdisciplinary study of computer vision. It employs algorithms to process and analyze images or videos, mimicking human vision. This technology extracts features, recognizes patterns, and interprets context, allowing machines to make decisions based on visual data. Applications span diverse domains, including facial recognition, object detection, medical image analysis, and autonomous vehicles. The evolution of deep learning has significantly advanced Computer Vision, enabling the creation of intricate neural networks that can accurately identify and interpret complex visual information, contributing to advancements in fields such as healthcare, robotics, and surveillance.

3) Deep Learning

Deep Learning, a subset of machine learning, employs neural networks with multiple layers (deep neural networks) to model complex patterns and representations. Inspired by the human brain, deep learning excels at tasks like image and speech recognition, natural language processing, and decision-making. Its depth allows for hierarchical feature extraction, enhancing accuracy and efficiency in handling intricate data. Training deep neural networks involves extensive datasets and computational power. With breakthroughs in algorithms and hardware, deep learning has revolutionized AI, driving advancements in various fields, from healthcare diagnostics and autonomous vehicles to natural language understanding and transformative applications in diverse industries.

4) Cognitive Learning

Cognitive learning refers to a process where individuals actively engage in acquiring knowledge, understanding, and problem-solving through perception, intuition, and experience. It encompasses higher mental functions like perception, memory, reasoning, and decision-making. Unlike rote memorization, cognitive learning emphasizes comprehension, critical thinking, and the application of learned concepts. This approach aligns with cognitive psychology theories, including those of Jean Piaget and Lev Vygotsky. Cognitive learning involves mental processes that enable individuals to organize, process, and retain information, fostering a deeper understanding of subjects. It plays a fundamental role in education, shaping how individuals perceive and interact with the world around them.

D. Characteristics of Artificial Intelligence

The key characteristics of artificial intelligence, which has led to the upsurge in its usage:

1) Natural Language Processing

A branch of linguistics, artificial intelligence, and computer science is commonly referred to as natural language processing. It renders it a possibility for computers to comprehend spoken or written words in human language (voice data) similar to individuals do. Regardless of whether the language is written or spoken, NLP employs Artificial Intelligence to analyze and interpret it so that the computer can comprehend it. NLP powers computer programmers that synthesize enormous quantities of text, translate text across languages, and instantaneously execute out spoken requests. Most of us have probably used voice-controlled GPS systems, language-to-text dictation software, virtual assistants, assistance chatbots, or speech recognition programmes, which are the most widespread NLP applications.

2) Perception

Machine perception makes it feasible to process and extrapolate all of the information contained in inputs from sensors (including cameras, wireless signals, and microphones). It is primarily employed in applications like object, facial, and speech recognition. The sole resource that offers visual input analysis is computer vision. Through the application of biometric mapping and artificial intelligence,

audiences are now able to identify specific faces. This groundbreaking technology involves comparing the information with a database of facial profiles to locate a corresponding match. Typically, this functionality is utilized for verifying the identities of employees or users, whether for workplace access or mobile device authentication. It operates by precisely identifying and analyzing facial attributes within a stored image.

3) Automate Simple and Repetitive Tasks

AI possesses an impressive capability to efficiently manage repetitive tasks without experiencing fatigue. To delve into this further, consider the example of SIRI, a voice-activated Virtual Personal Assistant developed by Apple. As its name suggests, it functions as an assistant and can handle numerous commands throughout a single day. Whether it's generating brief notes, rescheduling calendar events for specific meetings, or providing navigation guidance, SIRI can perform a wide range of tasks. In the past, these activities required manual execution, which consumed significant time and effort. However, with voice-enabled assistants, you simply need to speak your command, and it will swiftly complete the task, enhancing workplace safety and productivity.

4) Data Ingestion

AI enabled devices collect data, analyze previous experiences, and generate knowledge. Handling and extracting meaningful insights from vast amounts of data manually can be a time-consuming endeavor. However, AI has revolutionized this process. Data ingestion refers to the procedure of transferring unstructured data collected from various sources into a large database platform for the purpose of accessing, utilizing, and preparing AI models. Artificial Intelligence leverages logical reasoning to extract valuable insights through the analysis of extensive datasets using Artificial Neural Networks.

5) Imitation of Human Cognition

Artificial Intelligence has the capacity to mimic human thinking processes and address fundamental inquiries from customers, whether presented through audio or text-based input. Chatbots represent software powered by Artificial Intelligence, offering a means to listen to customer concerns and promptly provide solutions by responding to specific directives. These bots are intelligently designed to address customer issues within predefined parameters, but, if necessary, they can swiftly connect you with human representatives. In the past, interacting with these bots required extreme precision in your queries, but today, they not only comprehend commands but also the nuances of language, enabling them to offer effective solutions and even product recommendations in response.

E. Types of Artificial Intelligence

Types on the basis of capabilities:

1) Narrow AI

Narrow AI, excels in performing specific tasks intelligently, making it the most prevalent and readily available form of artificial intelligence. Constrained to a single function, narrow AI operates within defined boundaries, earning its moniker "weak AI." Notable instances include Apple Siri, which handles a limited set of tasks. However, when pushed beyond its designated scope, narrow AI may encounter unexpected failures. Examples of narrow AI applications encompass playing chess, providing purchase suggestions on e-commerce platforms, autonomous vehicles, speech recognition, and image identification, showcasing its proficiency in specialized yet limited domains.

2) General AI

General AI, a form of intelligence, possesses the capability to perform any intellectual task akin to a human. Its objective is to construct a system capable of independent learning and reasoning similar to a human being. Presently, no existing system qualifies as general AI, proficient in executing tasks as comprehensively as a human. Researchers globally are focused on crafting robots with the capacity for general AI functions. Due to ongoing research, the development of such systems entails significant effort and time, as the intricacies of creating machines with human-like cognitive abilities necessitate thorough exploration and refinement.

3) Super AI

Super AI represents a level of system intelligence where machines surpass human capabilities, outperforming them in various cognitive tasks. It emerges from advancements in AI, characterized by essential features like independent understanding, reasoning, problem-solving, judgment-making, planning, learning, and communication. Super AI remains a futuristic concept in artificial intelligence, and the development of such systems constitutes a groundbreaking endeavor in the real world. The complexity of creating machines with superior cognitive abilities underscores the transformative nature of this ongoing effort.

Types on the basis of functionality:

1) Reactive AI

Reactive AI, also known as rule-based AI, relies on predetermined instructions and fixed rules to respond to specific inputs or situations. It lacks the ability to learn from data or adapt over time, making it suitable for well-defined tasks with limited variability. Reactive AI is deterministic, producing consistent but inflexible outcomes. Examples include traditional expert systems used in specific domains like medical diagnosis. However, its limited adaptability makes it less suitable for complex or dynamic environments, prompting the development of more flexible AI approaches.

2) Limited memory machines

Limited Memory AI, also known as "Limited Memory Reinforcement Learning," operates with a constrained memory capacity, allowing it to remember only a subset of past experiences. This approach is often used in scenarios where a complete history of data isn't necessary. Limited Memory AI is well-suited for tasks like robotic control and game playing, where making decisions based on recent experiences is more important than maintaining a comprehensive memory of all past interactions, enabling more efficient and real-time decision-making.

3) Theory of mind

Theory of Mind AI is an emerging field in artificial intelligence that aims to imbue AI systems with the ability to understand and interpret the mental states and intentions of humans or other AI agents. This involves recognizing emotions, beliefs, desires, and intentions. This capability is essential for more natural and effective human-AI interactions, including chatbots, virtual assistants, and autonomous systems. Developing AI with a theory of mind can lead to more empathetic and context-aware AI interactions.

4) Self-aware AI

Self-aware AI, often considered a theoretical concept, refers to artificial intelligence systems with the capacity to possess consciousness and self-awareness similar to human beings. Such AI would not only process information but also recognize its existence, emotions, and thoughts. Achieving self-aware AI remains a highly complex and philosophical challenge. It raises ethical questions regarding AI's rights, responsibilities, and the potential risks associated with self-aware entities, making it a subject of significant debate and exploration in the field of AI ethics and philosophy.

F. Application of Artificial Intelligence

Artificial Intelligence (AI) continues to emerge as a groundbreaking solution with versatile applications. Every day, new use cases for AI are discovered, presenting potential solutions to various contemporary challenges across diverse fields. While its successful implementation in Robotics and Chatbots has been notable, the proposed applications of AI span a wide range of scenarios due to its exceptional features. Although this section covers only a handful of applications within the study's scope, Figure 3 illustrates the extensive use cases of artificial intelligence.

1) Healthcare

Artificial Intelligence (AI) has profoundly impacted healthcare across various domains. In diagnostics, AI algorithms analyze medical imaging data, such as CT scans and MRIs, with remarkable speed and accuracy, aiding in the early detection of diseases. AI-driven predictive analytics leverage patient data to identify potential health risks and personalize treatment plans, enabling proactive and preventive healthcare measures. Natural Language Processing (NLP) in AI processes and understands unstructured clinical data, improving the extraction of insights from electronic health records, enhancing clinical decision-making. Chatbots and virtual health assistants, powered by AI, are transforming patient interactions by providing real-time, personalized information, scheduling appointments, and monitoring health conditions. In drug discovery, AI expedites the identification of potential drug candidates by analyzing vast datasets, significantly reducing research and development timelines. Additionally, AI streamlines administrative tasks, such as billing and appointment scheduling, optimizing operational efficiency. Overall, the integration of AI in healthcare holds the promise of improving diagnostics, treatment efficacy, patient outcomes, and operational efficiency, ushering in a new era of data-driven and patient-centered care.

2) Business

Artificial Intelligence (AI) is reshaping the landscape of business operations across diverse sectors. In customer service, AI-powered chatbots provide instant, personalized responses, enhancing user experience and freeing up human resources. Predictive analytics, driven by AI algorithms, empower businesses to forecast trends, optimize inventory management, and make data-driven decisions for improved efficiency and cost-effectiveness. AI-driven marketing tools analyze consumer behavior, preferences, and trends, allowing businesses to tailor their strategies and campaigns. Human Resources benefit from AI in talent acquisition, automating resume screening and candidate matching processes. Furthermore, AI-driven tools assist in supply chain management by predicting demand fluctuations and optimizing logistics. In strategic planning, AI aids in market research and competitive analysis, providing valuable insights for decision-makers. Overall, the integration of AI in business operations streamlines processes, enhances decision-making, and fosters innovation, making it a transformative force in the contemporary business landscape.

3) Education

Artificial Intelligence (AI) is revolutionizing the education sector, offering innovative solutions to enhance learning experiences. AI-powered adaptive learning platforms analyze students' progress and tailor educational content to individual needs, fostering personalized and efficient learning. Intelligent tutoring systems leverage AI to provide immediate feedback and support, aiding students in grasping complex concepts. AI applications in education also include automating administrative tasks, such as grading and scheduling, freeing up educators to focus on teaching. Natural Language Processing (NLP) facilitates language learning by providing real-time language correction and pronunciation feedback. Virtual reality and AI combine to create immersive educational experiences,

Table 1
Artificial Intelligence SWOT Analysis

Strengths: 1. Data Processing Power: AI systems can process and analyze vast amounts of data quickly and efficiently. 2. Automation: AI enables automation of repetitive tasks, leading to increased efficiency and productivity. 3. Learning and Adaptation: Machine learning algorithms can improve over time by learning from new data and experiences.	*Weaknesses:* 1. Data Dependency: AI systems heavily rely on quality and quantity of data, and biases in data may lead to skewed results. 2. Initial Costs: Developing AI technologies can be expensive, limiting access for smaller businesses. 3. Ethical Concerns: Issues related to privacy, bias, and the ethical use of AI pose challenges to its adoption.
Opportunities: 1. Enhanced Customer Experience: AI-powered chatbots and customer service tools can improve customer interactions and satisfaction. 2. Innovation and Research: AI facilitates innovation in fields like robotics, autonomous vehicles, and other emerging technologies.	*Threats:* 1. Job Displacement: Automation of tasks may lead to job displacement and require retraining of the workforce. 2. Security Concerns: Risks of malicious use of AI, including hacking and manipulation of AI systems.

allowing students to explore historical events or scientific phenomena in a virtual environment. Moreover, AI enhances data analytics to track and predict student performance, enabling early intervention strategies for those at risk. Smart content recommendations and chatbots further contribute to a dynamic and engaging learning environment. Overall, the integration of AI in education aims to cater to diverse learning styles, improve outcomes, and prepare students for the challenges of a technology-driven future.

4) IoT and smart cities

In the context of the Internet of Things (IoT) and smart cities, Artificial Intelligence (AI) plays a pivotal role in optimizing urban infrastructure and enhancing connectivity. AI-powered analytics processes vast amounts of data generated by IoT devices, enabling real-time insights for efficient city management. In smart cities, AI facilitates intelligent traffic management, predicting congestion patterns and optimizing traffic flow. Predictive maintenance of infrastructure, such as streetlights and utilities, is achieved through AI algorithms analyzing IoT sensor data. Additionally, AI enhances public safety by integrating data from surveillance cameras and other sensors to detect anomalies or potential security threats. Smart energy grids benefit from AI-driven optimization, adjusting energy distribution based on real-time demand patterns. Overall, the synergy between AI and IoT in smart cities leads to more sustainable, efficient, and responsive urban environments, addressing challenges and improving the quality of life for residents.

5) Automobile Industry

Artificial Intelligence (AI) has revolutionized the automotive industry, introducing a myriad of applications that enhance safety, efficiency, and overall driving experience. One prominent area is autonomous driving, where AI algorithms, powered by sensors and cameras, enable vehicles to navigate, interpret their surroundings, and make split-second decisions. Predictive maintenance, another crucial application, employs AI to analyze vehicle data, anticipating maintenance needs and minimizing downtime. In-cabin AI assistants, driven by Natural Language Processing (NLP), provide hands-free control over vehicle functions, offering a seamless and safe interaction for drivers. Advanced Driver Assistance Systems (ADAS) leverage AI for features like adaptive cruise control and collision avoidance, enhancing road safety. AI extends its impact to traffic management, supply chain optimization, and cybersecurity, collectively transforming the automotive landscape. With ongoing advancements, AI continues to shape the future of automobiles, making them not just modes of transportation but intelligent, connected, and efficient systems.

6) Agriculture

Artificial Intelligence (AI) is reshaping agriculture, offering innovative solutions to address the challenges of modern farming. AI applications in agriculture include precision farming, where sensors and AI algorithms analyze data to optimize crop management, irrigation, and fertilization, leading to improved yields and resource efficiency. Machine learning models predict crop diseases and pests, enabling timely interventions and reducing crop losses. AI-powered drones and satellite imagery provide farmers with real-time insights into crop health, allowing for targeted actions. Autonomous vehicles equipped with AI navigate fields for tasks like planting and harvesting, enhancing operational efficiency. Furthermore, AI assists in crop breeding by analyzing genetic data, accelerating the development of resilient and high-yielding varieties. These applications showcase how AI is revolutionizing traditional farming practices, promoting sustainability, and contributing to a more productive and resilient agricultural sector in the face of evolving global demands and environmental changes.

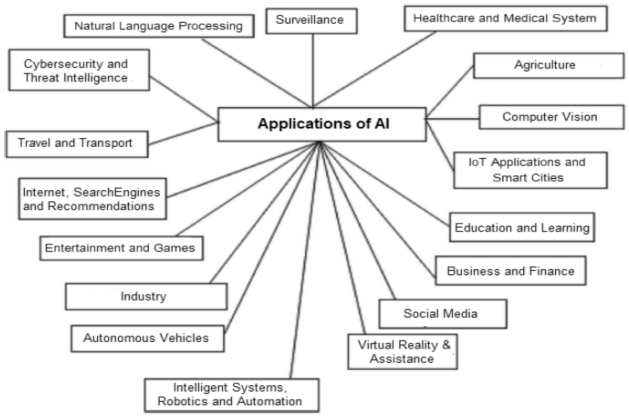

Fig. 3. Application of AI

Image Source: AI-Based Modeling: Techniques, Applications and Research Issues Towards Automation, Intelligent and Smart Systems (Iqbal H. Sarker, 2022)

3. Finance Industry

Before we dive into the intricate applications of artificial intelligence in the finance industry to solve the problems of unbanked people, we must understand and address the existing systems, the problems associated with it so as to make calculated decisions about the issues that can be solved by applying the features of artificial intelligence.

A. Understanding Traditional Finance Industry

The traditional banking system, a longstanding pillar of the financial landscape, operates through physical bank branches and in-person interactions. Customers engage in face-to-face transactions, including deposits, withdrawals, and account management. This system relies heavily on paper-based processes and manual record-keeping. Loan applications often require extensive documentation and approval processes. The traditional banking model is characterized by a network of physical branches, ATM services, and a reliance on established regulatory frameworks. While it offers a sense of security and personalized service, the traditional banking system faces challenges such as slower processing times, limited accessibility in remote areas, and higher operating costs. In recent times, this model is evolving as banks integrate digital technologies to enhance efficiency and offer online banking services, adapting to the changing preferences and expectations of customers in an increasingly digital era.

B. Definition of Unbanked and Underbanked

Individuals who lack access to or do not utilize mainstream

financial services, such as savings accounts, credit cards, or personal checks, are commonly referred to as "unbanked." These individuals typically make transactions using cash, money orders, or prepaid debit cards for their purchases and often do not engage in other financial instruments like insurance or pensions.

On the other hand, the term "underbanked" is used to describe individuals or families who possess a bank account but frequently employ payday loans, money orders, cheque cashing services, and other alternative financial services instead of conventional loans and credit cards to handle their affairs. This reliance on alternatives may stem from a lack of access to convenient and affordable banking services or a preference for non-traditional financial solutions. According to the Federal Reserve, approximately 13% of U.S. adults fall into the category of underbanked.

C. Problems Faced by Unbanked & Underbanked Population

1) No credit history

Traditional banks are unable to access the financial data of individuals who lack banking options, making it impossible for them to generate FICO or credit scores. The absence of a credit history has severe consequences for these individuals, leaving them vulnerable to the practices of unscrupulous lenders, such as those offering payday loans with exorbitant annualized interest rates.

Consumers without access to traditional banking services may resort to non-bank credit options like buy here, pay here (BHPH) and payday loans. These alternatives often impose excessively high interest fees, with BHPH loans reaching rates as steep as 20%. The Consumer Financial Protection Bureau (CFPB) cautions that payday loans can carry the equivalent of a staggering 400% interest rate. In stark contrast, traditional bank auto loans typically feature rates below 6%, and credit card APRs range from 15% to 29%. The interest rates associated with BHPH and payday loans are deemed predatory in comparison.

2) Lack of access to credit

Individuals without access to traditional banking services frequently resort to using prepaid cards to conduct transactions typically associated with credit cards for regular banking customers. While prepaid cards serve as a crucial resource for the unbanked population, they often come with extra fees. Cashing a check can incur charges ranging from a few dollars to well over $10, and money orders may involve fees of up to $2 or more each. For a household with dual incomes, receiving biweekly pay checks and handling at least two monthly bills using money orders, these fees could accumulate to over $150 annually. The absence of a credit history poses challenges for the unbanked in obtaining loans. Furthermore, the lack of a credit history can have adverse effects, as it may be taken into consideration by potential employers, landlords, utility providers, and insurers when making decisions about employment, rental agreements, service provision without a deposit, and insurance coverage.

3) Difficulty building an emergency fund

Having a reserve for future expenses is a fundamental aspect of maintaining financial well-being. According to the Microcredit Summit, an organization dedicated to uplifting American families from poverty, the average amount borrowed through a payday loan was $375 as of 2020. One significant advantage of possessing an emergency fund is the avoidance of the high fees and interest rates associated with payday loans. However, establishing such savings, even at the level of $375, proves challenging for individuals who are unbanked or underbanked. This difficulty arises in part because the available options for saving money in such households can be expensive. Storing money in cash at home exposes one to the risk of theft, and the value of the money diminishes over time due to inflation. Loading extra cash onto a prepaid card can mitigate theft risk, but it involves paying fees associated with the card. Moreover, both these savings options present the temptation to spend since the money is readily available in a spendable form. In contrast, traditional savings accounts, CDs, and money market accounts emerge as more efficient avenues for savings. Not only are they often devoid of fees (though exceptions exist), but they also accrue interest on deposits, enabling the money to grow rather than deplete over time.

D. Artificial Intelligence in Financial Inclusion

1) AI and Credit Decisions

Artificial intelligence (AI) presents a more efficient, accurate, and cost-effective method for analyzing potential borrowers, considering a broader array of variables and leading to well-informed decisions backed by data. AI-driven credit scoring relies on sophisticated and intricate rules, surpassing the complexity of traditional credit rating systems. This technology aids lenders in distinguishing between applicants with a significant risk of default and those who are creditworthy despite lacking an extensive credit history.

Objectivity is a notable advantage of the AI-driven process, as machines are less prone to bias than humans. Digital banks and loan-issuing applications leverage machine learning algorithms to assess loan eligibility and offer customized options, often incorporating alternative data such as smartphone usage. In the United States, automobile lending companies have reported success with AI implementation, demonstrating a 23% reduction in losses annually. A study utilizing data from the World Bank's Enterprise Surveys, spanning 63 economies and over 75,000 firms, revealed that establishing a credit bureau enhances firms' access to finance. This improved access includes longer-term loans, lower interest rates, and a higher share of working capital financed by banks. The study highlighted that the greater the credit bureau's coverage, the broader the scope and accessibility of credit information.

As of May 2019, the World Bank reported that 117 out of 191 studied economies had at least one credit bureau, covering varying percentages of the working-age population. About one-third of these economies introduced their first credit bureau in the past decade, with more economies in the process of establishing one. In all 117 economies, banks and financial institutions can access credit bureau data online through a website interface or system-to-system connection. Additionally, approximately 77 economies allow customers to

request access to their credit data online, read and comprehend their credit reports, and dispute credit data. The largest credit bureau provides credit scoring along with an online explanation of these scores and their general calculation methods.

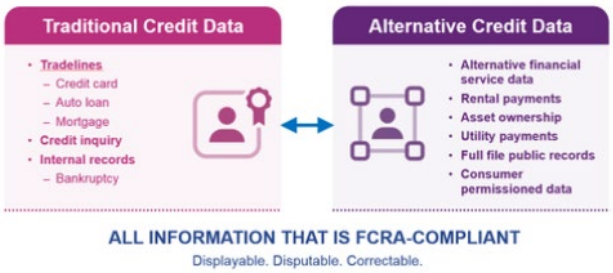

Fig. 4.
Image Source: What is Alternative Credit Data?
https://www.experian.com/blogs/insights/2018/09/what-is-alternative-credit-data/

2) AI and Personalized Banking

Within the banking sector, artificial intelligence (AI) plays a pivotal role in empowering smart chatbots that offer clients comprehensive self-help solutions, thereby reducing the workload on call centers. Voice-controlled virtual assistants, such as those powered by Amazon's Alexa, are rapidly gaining popularity. These assistants, equipped with self-education features, continually enhance their intelligence, promising significant improvements over time. Both smart chatbots and virtual assistants can perform tasks such as checking balances, scheduling payments, and retrieving account activity. Numerous apps leverage AI to provide personalized financial advice, assisting individuals in reaching their financial goals.

These intelligent systems meticulously track income, recurring expenses, and spending habits to formulate optimized plans and offer financial tips. Major U.S. banks like Wells Fargo, Bank of America, and Chase have introduced mobile banking apps that not only remind clients to pay bills but also facilitate easier and more streamlined interactions with the bank, covering everything from obtaining information to completing transactions. TymeBank in South Africa positions itself as a "fully digital bank" and utilizes AI to engage with customers online and through kiosks. Notably, the bank operates without human assistance at call centers and branches, allowing for cost-effective service provision.

As an example of cost efficiency, TymeBank's card replacement charge is R40, in contrast to FNB's R110 and Standard Bank's R55, as reported in a November 14, 2019, article on South Africa's business news website BusinessTech. Additionally, TymeBank's system is linked with the Department of Home Affairs database to capture biometric data for customer identity verification at kiosks.

4. Conclusion

In conclusion, this research paper has undertaken a comprehensive examination of Artificial Intelligence (AI) and its multifaceted applications, subsequently focusing on its pivotal role in addressing the pressing issue of financial inclusion for the unbanked population. The exploration of AI's foundational principles, including machine learning and data analytics, illuminated the transformative capabilities that underpin its applications. By navigating through various sectors, from healthcare to finance, the study highlighted the versatility of AI in reshaping industries and optimizing processes.

The central focus, however, has been on leveraging AI as a potent tool to alleviate the challenges faced by the unbanked. Through initiatives like mobile banking, digital identity verification, and alternative credit scoring, AI emerges as a catalyst for fostering financial inclusion. The potential to provide tailored and accessible financial services to the unbanked represents a paradigm shift in addressing socio-economic disparities.

As this research illuminates the promises of AI, it also underscores the need for responsible and ethical deployment. Striking a balance between technological innovation and ensuring equitable access to financial resources requires collaborative efforts from governments, financial institutions, and technology developers. While AI offers unprecedented opportunities, its implementation must be guided by ethical considerations to avoid exacerbating existing inequalities.

Looking forward, the integration of AI in financial inclusion initiatives holds the promise of not just connecting the unbanked but also fostering economic empowerment, spurring entrepreneurship, and contributing to overall societal development. This research advocates for continued research, policy frameworks, and industry collaborations to harness the full potential of AI in creating a more inclusive and equitable global financial landscape.

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