

# **A Hybrid Inventorship Model for AI Innovations: Bridging the Gap Between Human Accountability and Machine Creativity, with a Focus on the Indian Patent System**

## **Abstract:**

The advent of artificial intelligence (AI) is rapidly transforming innovation landscapes across various industries worldwide. From autonomous vehicles to precision agriculture and healthcare diagnostics, AI's capacity to generate novel solutions is unparalleled [1]. However, traditional patent systems in countries like India, the U.S., and the UK continue to recognize only human inventors, creating a legal and regulatory disconnect with emerging technologies [2]. This misalignment between technological progress and the rigidity of current legal frameworks has ignited global debates on whether AI can be recognized as an inventor in the patenting process [3]. This paper critically examines the challenges posed by AI-generated inventions within the traditional patent law structure, arguing that a hybrid inventorship model is the key to addressing these issues [4]. This model would formally acknowledge AI's contributions while ensuring human oversight and accountability, particularly within the context of Indian intellectual property law [5]. By adopting this approach, India stands to not only align itself with global trends but also enhance its patent output, driving innovation in AI-intensive sectors such as healthcare, agriculture, and information technology [6]. Additionally, this model could foster international collaboration, positioning India as a leader in AI-driven patenting while addressing the ethical and legal complexities surrounding AI-generated intellectual property [7].

## **1. Introduction:**

### **a. Contextual Background:**

Artificial Intelligence (AI) has undergone a significant transformation, evolving from a mere supportive tool to a pivotal driver of innovation across various sectors. This shift is exemplified by notable advancements such as IBM Watson's contributions to healthcare diagnostics and DeepMind's groundbreaking work on protein folding, which demonstrate AI's capacity to achieve levels of innovation previously thought to be the exclusive domain of human inventors [8]. The implications of these advancements extend beyond technological capabilities; they challenge existing intellectual property (IP) frameworks, which have historically recognized only human inventors. For instance, the case of *Thaler v. USPTO* in the United States, which denied AI inventorship, highlights the legal tensions arising from AI's autonomous generation of novel solutions that may qualify for patent protection [9]. Similar rejections have been observed in India, where the patent office has also denied patents listing AI as the sole inventor, underscoring the urgent need for legal adaptation to accommodate AI's contributions ("The Dilemma of the Intellectual Property System in the Context of Artificial Intelligence and the Path of Change", 2023). The rapid evolution of AI technologies has sparked a growing debate regarding the adequacy of current patent laws in addressing the complexities introduced by AI-generated inventions. As AI systems become increasingly capable of creating novel inventions, the traditional IP system faces significant challenges in maintaining its relevance and effectiveness [8]. The existing legal frameworks, such as India's Patents Act of 1970, do not account for the unique nature of AI as an inventor, which raises critical questions about the future of innovation and the protection of intellectual property [10]. Scholars argue that the current legal definitions of inventorship must be re-examined to include AI as a legitimate contributor to the inventive process, thereby ensuring that the benefits of AI-driven innovations are appropriately recognized and protected [9]. Moreover, the implications of AI on economic growth further complicate the discourse surrounding patent law and inventorship. Research indicates that AI patents have a significant positive impact on economic growth, suggesting that the integration of AI into

various sectors can drive innovation and enhance productivity [11]. This economic perspective reinforces the argument for adapting IP laws to better accommodate AI, as failing to do so may hinder the potential benefits that AI-driven innovations could bring to society[12]. The intersection of AI and IP law thus represents a critical area of inquiry, necessitating a comprehensive reevaluation of legal frameworks to ensure they remain effective in a rapidly evolving technological landscape [2,4].

#### **Purpose and scope:**

India is currently positioned at a critical juncture, where significant technological and economic transformations present an opportunity to modernize its patent system to accommodate AI-driven innovation. The proposal for a hybrid inventorship model, which recognizes AI as a co-inventor alongside human counterparts, aims to bridge the gap between machine creativity and human accountability. This model would ensure that while AI's contributions are acknowledged, the legal and ethical responsibility remains with a human inventor. Such an approach could potentially enhance India's patent filings, especially in burgeoning sectors like healthcare, agriculture, and information technology, thereby positioning the country as a global leader in AI-driven innovation [13]. To address the key research questions regarding the legal recognition of AI systems as inventors under current patent laws in India, the U.S., and the UK, it is essential to analyze the existing legal frameworks. Current patent laws in these jurisdictions predominantly recognize human inventors, which raises questions about the feasibility of including AI as a legal inventor. In India, the Patents Act of 1970 does not explicitly provide for AI as an inventor, which aligns with the legal stance taken in other jurisdictions. The recognition of AI as a co-inventor would require substantial amendments to existing laws, reflecting the evolving nature of innovation driven by AI technologies [13]. The proposed hybrid inventorship model would necessitate a re-evaluation of India's legal framework to incorporate AI's role in the innovation process. This model could involve defining specific criteria under which AI contributions are recognized while ensuring that human inventors retain accountability for the inventions generated [14]. By establishing a clear legal framework that accommodates AI as a co-inventor, India could enhance its patent output, fostering an environment conducive to innovation and attracting investments in AI technologies [13]. Maintaining human accountability while recognizing AI's role in the innovation process is a critical aspect of this discussion. The hybrid model could stipulate that while AI systems contribute to the inventive process, the ultimate responsibility for the patent application and the ethical implications of the invention rests with human inventors [13]. This balance would ensure that the legal rights associated with patents are preserved while also acknowledging the transformative potential of AI in generating novel solutions [13][14].

## **2. Literature review:**

### **a. Current Legal Frameworks;**

India's patent laws are governed by the Patents Act of 1970, which stipulates that only natural persons—human beings—can be recognized as inventors. This limitation is mirrored in other major patent systems around the world. In the United States, for instance, 35 U.S.C. § 101 explicitly states that only human inventors are allowed, a stance reaffirmed by legal precedents such as the *Thaler v. USPTO* case, where a patent application listing an AI system as the inventor was rejected, as the court concluded that current patent law does not allow for non-human inventors [13]. Similarly, the UK Patents Act of 1977 also restricts inventorship to humans, creating a unified global stance that restricts AI from being legally recognized as an inventor[15]. Despite this consensus, the increasing role of AI in generating novel inventions has sparked calls for reform. AI is now capable of autonomously developing groundbreaking innovations, such as new pharmaceutical compounds and advanced machine learning algorithms, raising questions about how existing patent laws should evolve [14]. Legal experts argue that the current human-centered frameworks are becoming outdated in light of

AI's capabilities. For instance, Professor Ryan Abbott, a vocal proponent of AI inventorship, asserts that "excluding AI from patent rights is not only legally restrictive but also economically inefficient," as it overlooks a major source of innovation that could be vital in industries such as biotechnology and AI-based engineering [16]. The need for reform is further emphasized by the limitations imposed by existing legal frameworks, which do not adequately address the complexities introduced by AI-generated inventions. The current legal definitions of inventorship fail to account for the unique contributions of AI systems, which can autonomously create novel solutions that challenge traditional notions of creativity and inventorship [17]. As AI continues to advance, the legal landscape must adapt to ensure that it fosters innovation while maintaining the integrity of intellectual property rights [18].

#### **Comparative analysis of patient law:**

The comparative analysis of patent laws across various jurisdictions reveals a significant divergence in how countries are beginning to address the role of artificial intelligence (AI) in inventorship. The U.S., UK, and India maintain a traditional stance that limits inventorship to natural persons, reflecting a historical perspective on patent law that emphasizes human creativity and ingenuity. However, recent developments in countries like South Africa, which granted a patent listing an AI as an inventor, signal a potential shift in this paradigm. This landmark decision has sparked discussions among legal scholars and practitioners about the implications of recognizing AI as an inventor, suggesting that nations like India might benefit from reevaluating their patent frameworks to accommodate AI's contributions to innovation [19][20]. In Asia, countries such as Japan and South Korea are also engaging in dialogues regarding the integration of AI into their patent systems. Although no formal changes have been enacted yet, the discussions indicate a growing recognition of AI's role in technological advancement and the need for patent laws to evolve accordingly. This reflects a broader trend observed in patent filings, where nations are increasingly considering the implications of AI technologies on their intellectual property regimes [19]. The comparative analysis of patent data across multiple jurisdictions, including the U.S., Japan, and China, highlights the varying approaches to AI-related patents and the potential for cross-country learning in this domain[20][17]. China presents a unique case in this landscape. While its patent laws do not officially recognize AI as inventors, the country has aggressively promoted patent filings in AI-driven sectors, showcasing a pragmatic approach to fostering innovation. The Chinese government has implemented substantial incentives for AI-related innovations, which has led to a significant increase in patent applications in this field. This approach suggests that while the legal framework may not formally acknowledge AI as inventors, the practical implications of AI-driven innovations are being embraced within the existing patent system[22][21]. The dynamic nature of China's patent landscape, coupled with its focus on AI, illustrates a potential model for other nations grappling with similar challenges [18].

##### **i. Expert opinion and legal differences:**

Many legal scholars and practitioners argue that the rigid restrictions of current patent laws may stifle innovation. According to Dr. Andrew Torrance, a professor of intellectual property law, "modernizing patent systems to recognize AI's contributions, while maintaining human oversight, will better reflect the reality of how inventions are created today" [25]. He suggests that a hybrid inventorship model, which recognizes AI as a co-inventor but assigns legal and ethical responsibility to a human counterpart, could provide a balanced solution. This model, he argues, would preserve the integrity of human accountability while ensuring that AI's valuable contributions are acknowledged [24]. In the Indian context, legal experts like Manoj Pillai, an IP lawyer, have pointed out that "the Indian patent system is at a crossroads, and failing to adapt to AI's growing influence could limit the country's global competitiveness in key sectors like pharmaceuticals and IT" [23]. He advocates for targeted reforms that allow AI systems to be listed as co-inventors under human supervision, arguing that this would help bridge the gap between technological advancement and legal accountability. The

need for reform is echoed by other scholars who emphasize that the current legal frameworks may not adequately address the complexities introduced by AI technologies, potentially leading to a disadvantage in global innovation [24]. The differences between countries on how AI-generated inventions are treated could lead to a fragmented global patent system, with innovators seeking patents in jurisdictions that are more favorable to AI inventorship. For India, this raises significant implications. If India does not modernize its patent laws, it risks falling behind in sectors where AI-driven innovation is becoming critical, such as healthcare, agriculture, and information technology [23]. On the other hand, adopting a forward-thinking approach by integrating a hybrid inventorship model could place India at the forefront of AI innovation, aligning it with global leaders and attracting international investment [23].

## **2.2 the role of ai in indian innovation:**

India is increasingly leveraging artificial intelligence (AI) across a variety of sectors, positioning the country as a major player in the global AI landscape. As AI becomes integral to industries like healthcare, agriculture, information technology (IT), and manufacturing, its ability to solve complex problems and drive novel innovations has made it a key contributor to India's economic and technological growth. However, despite AI's transformative role in these industries, India's patent system remains outpaced by the speed of AI-driven innovations, which may hamper the country's competitiveness in the global patent race[26].

### **Sector-Specific Contributions**

#### **1. Healthcare:**

AI has had a significant impact on India's healthcare sector, particularly in areas like drug discovery, diagnostics, and personalized medicine. AI algorithms are being used to design new pharmaceutical compounds, expediting the development of life-saving drugs. For example, AI-based drug discovery platforms, like those employed by Bengaluru-based Strand Life Sciences, are generating thousands of potential drug candidates in a fraction of the time traditional methods take. According to a report by NASSCOM, AI could potentially add \$25 billion to India's healthcare sector by 2025, largely through breakthroughs in precision medicine and drug discovery [28]. The integration of AI in drug discovery has been highlighted in various studies, emphasizing its role in enhancing efficiency and accuracy in identifying viable drug candidates [27].

#### **2. Agriculture:**

In a country where agriculture employs a significant portion of the population, AI is playing a critical role in optimizing farming practices. AI-driven systems are enabling farmers to predict crop yields more accurately, manage resources more efficiently, and combat pests and diseases in real-time. For instance, AI platforms like CropIn use satellite imagery and machine learning to provide data-driven insights for Indian farmers, improving their productivity by 20% on average. Additionally, AI has been essential in developing sustainable farming solutions, such as precision irrigation and soil health monitoring, crucial for addressing India's food security challenges[29]

#### **3. Information Technology (IT):**

The IT sector has long been a backbone of India's economy, and AI is amplifying its potential. From Tata Consultancy Services (TCS) to Infosys, Indian IT companies are adopting AI to create autonomous systems, improve cybersecurity, and offer AI-driven cloud computing services. AI's role in automating business processes has allowed companies to improve efficiency, cut operational costs, and innovate in areas such as AI-driven chatbots and natural language processing (NLP), which have broad applications in customer service and software development[29].

#### **4. Manufacturing:**

AI is transforming India's manufacturing sector by integrating Industry 4.0 technologies like AI-driven robotics, predictive maintenance, and quality control automation. Companies such as Larsen & Toubro are deploying AI-powered systems to enhance factory productivity and reduce downtime. AI-driven predictive analytics, for instance, is being used to monitor machinery health, prevent failures, and optimize supply chains, contributing to the sector's overall efficiency [29].

#### **b. future trends in ai driven innovations and implications for patient fillings**

The future of AI-driven innovation in India is poised to undergo significant transformations across various sectors, particularly in the realm of intellectual property (IP), autonomous systems, interdisciplinary collaboration, and the empowerment of small and medium enterprises (SMEs). Each of these trends presents unique implications for patent filings and the legal framework surrounding them. Firstly, the integration of AI in the patent application process is becoming increasingly prominent. AI technologies are being utilized to conduct prior art searches, draft patent applications, and even predict the success of patent filings. This trend is particularly relevant in India, where the World Intellectual Property Organization (WIPO) has indicated that the use of AI in patent analytics could enhance the speed of patent filings [30]. Such advancements could alleviate the existing backlog in India's patent system, encouraging more innovators to file patents domestically. The potential for AI to streamline these processes aligns with the findings of Wang and Lin, who highlighted the role of AI in enhancing healthcare innovation through improved patent analysis [7]. Moreover, the emergence of fully autonomous AI systems capable of generating inventions without human intervention raises critical questions regarding patent law in India. Current legal frameworks predominantly recognize human inventors, which may not adequately address the complexities introduced by AI-generated innovations. As noted by Bar, denying patent protection for outputs generated by AI systems could hinder the overall innovation landscape, as it may exclude otherwise patentable solutions from protection [31]. This situation necessitates a reevaluation of the legal definitions surrounding inventorship to accommodate the contributions of AI. Interdisciplinary collaboration is another significant trend, where AI's capabilities are being harnessed across various sectors, including healthcare, agriculture, and information technology. This cross-sectoral innovation is likely to lead to an increase in patents that reflect the integration of knowledge from different domains. The work of Araújo et al. emphasizes the importance of patent co-inventorship networks in enhancing regional inventive performance, suggesting that collaboration can significantly influence innovation outcomes [32]. As AI systems are adapted for diverse applications, the potential for novel solutions increases, thereby driving a surge in patent filings. Furthermore, the accessibility of AI-driven innovation for SMEs in India is expected to expand. Platforms that democratize access to AI tools are enabling smaller enterprises to innovate without requiring extensive in-house expertise [33]. This democratization is crucial, as it could lead to a notable increase in patent filings from SMEs, thereby enriching the overall innovation ecosystem in India. The findings of Marda support this notion, indicating that AI is becoming a focal point in India's economic development strategies, particularly for smaller businesses [34]. The implications for patent filings in India are profound. As AI continues to generate novel solutions, the existing patent system must evolve to recognize AI-generated inventions. The current framework, which only acknowledges human inventors, poses significant hurdles for patent recognition of AI-driven innovations. A hybrid inventorship model, where AI is recognized as a co-inventor alongside human innovators, could bridge this gap and encourage more patent filings by ensuring legal protection for AI-generated innovations[6]. This approach would not only enhance the patent landscape but also uphold the principles of accountability and innovation integrity. In conclusion, AI is set to play a transformative role in reshaping innovation

across key sectors in India. The trends identified—AI in intellectual property, autonomous systems, cross-sector collaboration, and the empowerment of SMEs—highlight the need for a modernized patent system that reflects the realities of AI co-inventorship. By adapting to these changes, India can fully capitalize on the potential of AI-driven innovation, ensuring that both human and machine contributions are recognized in the patent process.

### **2.3 Gaps in the Indian Patent System**

The Indian patent system, governed by the Patents Act of 1970, was designed in an era where the idea of non-human inventors was inconceivable. While the system has seen several updates, it has struggled to keep pace with rapid technological advancements, particularly in emerging fields like artificial intelligence (AI). To fully harness India's potential as a global innovation hub, it is crucial to address several specific gaps in the current patent framework.

#### **2.3.1 Historical Context**

India's patent system has evolved significantly since independence. Prior to the Patents Act of 1970, the country followed the colonial Indian Patents and Designs Act of 1911, which offered minimal protections and was heavily criticized for stifling local innovation. The 1970 Act was a turning point, aligning Indian patent laws more closely with international standards while promoting indigenous innovation. However, global IP norms have shifted dramatically in recent decades with the rise of AI, biotechnology, and other advanced fields. While TRIPS (Trade-Related Aspects of Intellectual Property Rights) compliance in 2005 was another milestone, India's IP framework still lags behind in addressing the unique challenges posed by modern AI-driven inventions. Many advanced economies have begun to explore policies to incorporate AI in IP laws, leaving India in a reactive position rather than a proactive one [35].

#### **2.3.2 Specific Gaps**

##### **1. Lack of Clarity on AI Inventorship**

The current Patents Act does not recognize AI systems as inventors. This absence of clarity puts AI-generated inventions in a legal gray area, which hinders their protection and commercialization. For example, if an AI system generates a new drug compound, current laws prevent that invention from being patented unless a human is listed as the inventor. This discrepancy discourages R&D investments in AI-driven innovation and creates legal uncertainty for businesses that rely heavily on AI for innovation. The failure to recognize AI as an inventor delays the commercialization of AI-generated inventions. It can also lead to international disputes, as other countries start to grapple with AI inventorship, possibly leaving Indian innovators at a competitive disadvantage[35].

##### **2. Patent Examination Delays**

India has long struggled with a backlog in patent examinations, leading to delays that can last several years. In AI and other rapidly evolving fields, such delays are particularly harmful, as they stifle innovation and create uncertainty around intellectual property protection. In 2020, the average waiting time for a patent examination in India ranged from 3 to 5 years, while in countries like the U.S., the time frame is significantly shorter. For AI-related innovations, where time-to-market is crucial, such delays can mean the difference between market leadership and obsolescence. The delay discourages both domestic and foreign companies from filing patents in India, opting instead to focus on jurisdictions with quicker patent approval processes. This contributes to India's low patent filing rate, which, in 2020, was 56,771 applications compared to 597,141 in the U.S. and 1.5 million in China [36].

##### **3. Insufficient Expertise**

Patent examiners in India often lack specialized knowledge in emerging technologies such as AI, machine learning, and biotechnology. As a result, the examination of complex AI-generated inventions can be inconsistent or overly cautious. This gap in expertise is critical because AI-related inventions often involve interdisciplinary fields, requiring examiners to have a deep understanding of both AI algorithms and the specific industry (e.g., pharmaceuticals, agriculture). In sectors like healthcare, AI innovations—such as algorithms that predict diseases or suggest treatments—require examiners to understand both the AI's functionality and its application to medical science. Without the appropriate expertise, examiners may be unable to assess the novelty and non-obviousness of AI-driven inventions properly, leading to inconsistent or incorrect patent decisions [37].

#### **4. Enforcement Issues**

Even when patents are granted, enforcement of patent rights in India can be slow and inconsistent. Legal battles over patent infringement can take years to resolve, during which time the inventor may lose out on substantial commercial opportunities. This problem is exacerbated in sectors like AI and tech, where the pace of innovation far outstrips the legal system's ability to resolve disputes. Weak enforcement mechanisms discourage businesses from filing patents in India, especially in fast-moving industries like IT and pharmaceuticals, where AI is a critical driver of innovation. This lack of reliable enforcement further reduces the incentives for global companies to engage with the Indian patent system, thereby limiting foreign direct investment (FDI) in these sectors [38].

##### **2.3.3 case studies and stakeholder perspective**

The case studies presented highlight significant gaps in the patent system that adversely affect innovation, particularly in the fields of artificial intelligence (AI) and biotechnology. In the first case study, a domestic biotech firm employs AI to discover a novel compound for cancer treatment. The AI-driven process generates substantial data that supports a patent application; however, the ambiguity surrounding AI inventorship necessitates that the firm names a human inventor. This situation is compounded by a backlog in the patent examination process, resulting in a significant delay before the patent is granted. By this time, global competitors have already introduced similar drugs, severely undermining the firm's market share. This scenario exemplifies how the current patent framework can stifle innovation and economic viability in rapidly evolving sectors, where timely patent protection is essential for maintaining competitive advantage [39].

In the second case study, an Indian tech startup develops a novel AI algorithm for voice recognition and successfully patents its innovation. However, a global corporation subsequently integrates a similar algorithm into its products without authorization. The startup's attempt to seek legal redress through a lawsuit encounters significant delays, taking years to resolve due to inefficiencies in the legal system. By the time the startup receives compensation, the technology has become outdated, resulting in a weakened market position. This case underscores the urgent need for reform within the patent system to enhance the protection of intellectual property and ensure that innovators can effectively capitalize on their inventions [40].

Stakeholder perspectives reveal a consensus regarding the inadequacies of the current patent system, particularly in India. Inventors and innovators express frustration over the lack of clarity surrounding AI inventorship and the protracted delays in patent examinations, which hinder their ability to monetize their innovations. Legal experts advocate for comprehensive reforms to modernize the Patents Act, emphasizing the necessity of incorporating provisions for AI-generated inventions and improving the efficiency of patent examination and enforcement processes. Industry leaders in AI-driven sectors, such as pharmaceuticals and technology, view the limitations of the patent system as a significant barrier to innovation. They believe that addressing these gaps, particularly concerning AI inventorship, could unlock new avenues for growth and enhance India's attractiveness as a destination for investment in cutting-edge technologies [41] [42].

The proposed hybrid inventorship model seeks to address these challenges by recognizing AI as a co-inventor alongside human contributors. This model aims to balance the acknowledgment of AI's contributions with the accountability of human inventors. Key features of this model include recognizing AI's significant contributions to the inventive process while ensuring that a human retains full legal and ethical responsibility for the invention. This approach not only addresses the current gaps in patent law but also aligns with the evolving nature of innovation in fields such as pharmaceuticals and technology, where AI plays an increasingly integral role [43]. The hybrid model could facilitate a more equitable and efficient patent system, fostering innovation and ensuring that inventors can protect and commercialize their creations effectively [45].

### **3. Proposed Hybrid Inventorship Model**

As AI becomes increasingly integral to the innovation process, a hybrid inventorship model is proposed to address the challenges posed by traditional patent systems that exclusively recognize human inventors. In the context of India's evolving technological landscape, this model seeks to balance AI's contribution to innovation while ensuring that humans maintain accountability. Below, we provide a detailed explanation of the hybrid model, legal feasibility, and the potential impact on India's patent filings.

#### **3.1 Model Overview**

The hybrid inventorship model allows AI to be recognized as a co-inventor alongside a human. The core principles of this model ensure that AI's substantive contributions are acknowledged without diluting the legal and ethical responsibilities of human inventors. The key features of this model include:

1. **AI Contribution Recognition:** AI systems would be named as co-inventors when they contribute significantly to the invention process. These contributions might include tasks such as designing novel pharmaceutical compounds, developing cutting-edge algorithms, or solving complex problems that would be challenging for humans alone. For example, AI has been instrumental in drug discovery, where deep learning models have identified potential compounds that are then synthesized and tested by human scientists. In such cases, AI's contribution is not merely supplementary; it plays a key role in generating patentable innovations.

2. **Human Accountability:** While AI is recognized for its contributions, a human (or legal entity such as a corporation) retains full legal and ethical responsibility for the invention. This human co-inventor will be responsible for ensuring compliance with patent laws, including filing the patent application and addressing any legal, regulatory, or ethical concerns that may arise from the AI-generated invention. This mitigates concerns about liability and ensures there is a responsible party in case of disputes or challenges related to the invention. Accountability for AI bias is particularly critical in sectors such as healthcare, where faulty or biased AI decisions can have dire consequences [46].

3. **Inventorship Attribution:** Under the hybrid model, AI is formally acknowledged as a co-inventor, but patent rights would remain vested in the human co-inventor or organization. This ensures that the human, not the AI, handles all legal aspects of the patent, including ownership, commercialization, and enforcement. While AI contributes to the inventive process, it does not hold any rights, and the human remains the primary owner of the intellectual property.

##### **3.1.1 Examples of AI-Human Collaboration Leading to Innovation**

AI-human collaboration has already led to significant innovations across sectors. For example:

- In pharmaceuticals, AI-driven models have been crucial in predicting molecular structures for new drugs. For instance, AI-assisted drug discovery was pivotal in the development of potential treatments for COVID-19, where machine learning algorithms screened millions of compounds in record time, narrowing down options for human researchers to test [47].

- In agriculture, AI systems optimize irrigation, fertilizer use, and pest control, improving crop yields and sustainability. For example, the collaboration between AI algorithms and agricultural experts has resulted in AI-powered precision farming solutions, which ensure that resources are used efficiently to boost productivity while minimizing environmental impact [48].
- In technology, companies like Google's DeepMind have collaborated with human scientists to solve complex problems, such as protein folding, which has implications for biological research and drug development [49].

These examples highlight how AI's creative and analytical capabilities complement human ingenuity, leading to innovations that neither could achieve alone.

### **3.1.2 Case Studies and Hypothetical Scenarios**

To illustrate how the hybrid inventorship model could work in practice, consider the following case studies:

- **Case Study 1: AI in Drug Discovery**

A pharmaceutical company develops an AI-driven platform that identifies promising compounds for cancer treatment. The AI system screens billions of potential molecules, narrowing down a few candidates based on their chemical properties. The human researchers then synthesize these compounds and conduct clinical trials. Under the hybrid inventorship model, the AI would be listed as a co-inventor for its role in generating novel compounds, while the human researchers retain full accountability for testing, filing patents, and commercialization [50].

- **Case Study 2: AI in Autonomous Vehicles**

An automobile manufacturer uses AI to develop a new self-driving algorithm that significantly improves the safety and efficiency of autonomous vehicles. The AI system, trained on large datasets, generates a novel algorithm that optimizes the vehicle's decision-making in complex environments. The company's engineers integrate this algorithm into their vehicle designs. In this scenario, the AI could be named as a co-inventor, but the human engineers would remain responsible for patent filings and ensuring the vehicle complies with safety standards [51].

### **3.2 legal feasibility in india**

1. Expansion of Inventor Definition: Section 6(1) of the Patents Act defines an inventor as a "natural person," which excludes AI. To accommodate the hybrid model, this section could be amended to recognize AI systems as co-inventors, provided a human is also listed. This adjustment would ensure that AI's contributions are formally recognized without undermining the requirement for human responsibility. The legal implications of such a change have been discussed in various studies, which emphasize the need for a redefinition of inventorship to include AI as a legitimate contributor to innovation (Adaka & Olubiyi, 2022; Nguyen & Quan, 2023)[52][53].

2. Non-Obviousness Criteria: AI's role in generating inventive steps must also be acknowledged under the non-obviousness criteria in Section 2(1)(ja). The inventive steps produced by AI systems, especially in fields like machine learning and data analytics, could challenge existing notions of obviousness. Patent examiners would need to be trained to assess AI-driven innovations fairly and consistently. The complexity of evaluating AI-generated inventions has been highlighted in recent literature, which suggests that traditional metrics for assessing non-obviousness may not adequately capture the nuances introduced by AI technologies (Meskó et al., 2023; Fraser, 2016)[54][55].

3. Potential Impact on India's Patent Statistics: By adopting the hybrid inventorship model, India could experience a significant boost in its patent filings, especially in AI-driven sectors like pharmaceuticals, agriculture, biotechnology, and IT. Studies have shown that nations embracing AI in

their patent systems, like the U.S. and China, are seeing rapid increases in filings. For example, a study by [56] found that AI innovation in biotechnology alone could lead to substantial increases in patent filings in certain sectors over the next decade. In India, embracing AI-generated innovations could encourage both domestic and international companies to invest more in research and development, knowing that their AI-generated inventions will receive patent protection. This, in turn, would bolster India's standing as a global innovation hub, narrowing the gap with innovation leaders like the U.S. and China [57][58]

**3.1 Hypothetical Scenario: Growth in AI Patents:** Consider a hypothetical scenario where India implements the hybrid model. A biotechnology startup uses AI to identify new proteins with potential medical applications. The AI discovers a unique protein structure that can be used in creating a new vaccine. The human scientists file a patent with AI listed as a co-inventor. As a result, the patent is granted, increasing India's pharmaceutical patent filings and attracting global attention to India's capabilities in biotech innovation. This scenario illustrates the potential for increased patent activity in India, which could lead to enhanced investment in AI and biotechnology sectors (Abadi & Pecht, 2020; Matulionyte & Lee, 2022)[59][60]

#### **4. Ethical and legal considerations**

The intersection of AI and inventorship introduces a host of ethical and legal concerns, from the accountability of AI-generated inventions to issues of transparency and bias. As AI's role in innovation grows, it becomes essential to address these challenges to ensure the responsible deployment of AI-driven technologies. Any legal reforms that recognize AI in the patent process must navigate these ethical dilemmas to maintain both the integrity of the patent system and public trust in AI.

**4.1 Accountability and Ownership:** Accountability remains one of the most pressing ethical concerns in AI inventorship. If an AI system generates a new invention or contributes significantly to its development, a critical question arises: Who should be held responsible for the invention's outcomes, particularly if those outcomes result in harm or legal violations? Under the proposed hybrid inventorship model, the human co-inventor would assume full responsibility for the AI's contributions. This ensures that, although the AI plays a pivotal role in the invention process, a human remains accountable for the ethical and legal implications of the innovation. This approach aligns with existing legal norms, which mandate human oversight and responsibility for the actions of AI systems, even in cases where the AI makes independent decisions Gurgula [61].

For instance, autonomous medical diagnostics tools powered by AI may misdiagnose a patient due to faulty algorithms or biased data. If such a system contributes to the development of a patented diagnostic tool, the human co-inventor must be held accountable for any negative outcomes, ensuring that AI is used responsibly and ethically in critical sectors like healthcare. Similar concerns are prevalent in autonomous vehicle systems, where AI-driven inventions could result in accidents or safety violations. Ensuring human accountability mitigates the risks posed by AI-generated inventions, as it emphasizes the need for human oversight in the deployment of AI technologies [62].

Moreover, the ethical implications of AI in inventorship extend beyond accountability to encompass issues of transparency and bias. The algorithms driving AI systems can perpetuate existing biases present in the data they are trained on, leading to skewed outcomes that may not align with ethical standards. This raises questions about the fairness of patenting inventions that may have been influenced by biased data sets, as it could lead to inequities in innovation and intellectual property rights [52].

The legal framework surrounding AI inventorship must also consider how to address these biases effectively. This involves not only holding human co-inventors accountable but also establishing guidelines for the ethical training and deployment of AI systems. Such measures would

help ensure that AI-generated inventions are developed in a manner that is consistent with societal values and ethical standards [63]

#### 4.2 ethical dilemma , Legal Precedents and Implications for a Hybrid Inventorship Model

The ethical dilemmas surrounding transparency, bias, and fairness in artificial intelligence (AI) systems are particularly pronounced in a diverse country like India, where these technologies can significantly impact various socio-economic groups. AI systems, if not carefully designed and monitored, can inadvertently reflect and exacerbate existing inequalities, leading to biased outcomes in critical sectors such as healthcare, education, and agriculture. For example, in healthcare, biased algorithms may result in disparities in treatment recommendations for different demographic groups, particularly in regions where healthcare access is already inequitable. This concern is echoed in the literature, which highlights the importance of addressing ethical considerations in AI integration within healthcare settings [63][64][65][60]

In the agricultural sector, the implications of biased AI systems are equally concerning. AI technologies designed to optimize crop yields must be inclusive, ensuring that small-scale farmers, especially those from disadvantaged backgrounds, are not excluded from the benefits of innovation. A notable instance occurred in 2019 when a bias in AI-based weather prediction algorithms led to inaccurate data being provided to smallholder farmers in India, disproportionately affecting their productivity compared to larger commercial farms. This case underscores the urgent need for robust oversight mechanisms to ensure fairness and equity in AI-driven agricultural innovations [52][57][66]

Moreover, ethical dilemmas also arise in sensitive areas such as criminal justice and financial services, where biased AI algorithms can lead to wrongful convictions or discriminatory lending practices. The stakes are particularly high in these domains, as even minor inaccuracies can have severe real-world consequences. The literature emphasizes the necessity of ensuring that AI-generated inventions in these critical areas are devoid of bias, as the ramifications of biased decision-making can be catastrophic (Jeyaraman, 2023; Hammod, 2023; Kooli & Muftah, 2022)[66][54][67]

To address these pressing ethical concerns, a hybrid inventorship model could be proposed, necessitating a transparent AI development process. This model would require mandatory reporting on the training processes of AI systems, the datasets utilized, and the decision-making pathways followed by the AI in contributing to an invention. Such transparency would facilitate external scrutiny of AI systems, enabling the identification and rectification of biases before they manifest in real-world applications. This approach aligns with the recommendations from various scholars advocating for ethical frameworks that prioritize transparency and accountability in AI systems.[68][69][70]

In the context of healthcare, ethical considerations are paramount, particularly as AI technologies become more integrated into clinical practice. Studies have shown that the integration of AI in healthcare raises significant ethical concerns related to privacy, data security, bias, and fairness. For instance, the potential for AI systems to perpetuate existing biases in healthcare delivery is a critical issue that must be addressed through comprehensive ethical guidelines and regulatory frameworks [65][58][56][71]. The literature suggests that establishing clear guidelines for responsible AI use in healthcare is essential to mitigate risks and ensure equitable access to AI-driven innovations [72][73][74]

Legal precedents also play a crucial role in shaping the discourse around AI inventorship and accountability. Current rulings often reject the notion of AI as an inventor, as seen in the landmark case of *Thaler v. USPTO* (2020), where the court ruled that AI systems cannot be recognized as inventors under U.S. patent law. This decision reinforces the requirement for human inventorship in the patent process, even when AI significantly contributes to generating an invention. Similar rulings in the UK and Australia have sparked debates among legal experts advocating for reforms to better reflect the realities of modern AI-driven innovation[55][63][62]

In India, legal expert Rajiv Dutta has argued for the adaptation of the patent system to recognize AI as a co-inventor alongside human contributors. This perspective aligns with the views of several legal scholars who emphasize the need for India to modernize its legal frameworks to accommodate the rise of AI in innovation. A hybrid inventorship model could serve as a viable legal reform, allowing India to keep pace with global innovation trends while ensuring that human accountability remains central to the patent process [60][75].

The creation of AI-specific patent categories could be one potential avenue for reform, where AI systems are recognized as contributing inventors while a human retains overall accountability for the ethical and legal consequences of the invention. This approach would not only align with global trends but also promote inclusivity in the inventorship process, ensuring that the contributions of AI are acknowledged without undermining the essential role of human oversight [76][52][72].

## **5. Practical implementation in india**

To successfully implement the hybrid inventorship model in India, a comprehensive strategy is essential. This strategy would encompass legal reforms, administrative updates, and initiatives to foster awareness and collaboration. Below is a step-by-step roadmap, along with specific recommendations for ensuring a smooth transition to recognizing AI as a co-inventor while maintaining human oversight.

### **5.1 Step-by-Step Roadmap for Implementation**

#### **Short-Term Steps:**

##### **1. Amendments to the Patents Act:**

- Introduce a clause that ensures human accountability remains intact, stipulating that human inventors or organizations are legally and ethically responsible for the AI-generated inventions. This accountability is vital to maintain ethical standards and prevent misuse of AI technologies[52].

##### **2. Updated Patent Office Guidelines:**

- The Indian Patent Office (IPO) would need to update its examination guidelines to recognize AI contributions under specific conditions, such as generating a novel drug compound or an innovative industrial process. This would involve developing clear criteria to assess when AI has made a substantive contribution deserving of co-inventorship [54][67]

- Patent examiners should receive training on AI-related inventions to ensure they can properly evaluate AI's role in the invention process. Specialized units within the IPO could be created to focus on emerging technologies like AI and biotechnology, ensuring that the patent examination process is equipped to handle the complexities introduced by AI [54].

##### **3. Pilot Programs:**

- Launch pilot programs in sectors where AI has already shown substantial promise, such as pharmaceuticals and agriculture. These programs would allow for limited implementation of the hybrid inventorship model, helping to refine the guidelines and assess any unforeseen legal or administrative challenges [77][19].

- Collaborate with industry leaders to identify specific AI-driven innovations that could be tested under this pilot framework, ensuring both legal and economic feasibility. This collaboration would facilitate a practical understanding of how AI can be integrated into the inventorship process [78][73].

**Long-Term Steps:**

**4. Comprehensive Legal Reforms:**

- After the pilot phase, based on the findings, introduce more comprehensive legal reforms that integrate AI recognition into the broader intellectual property framework. This would include reforms not only to patent laws but also to trade secrets and copyright laws to accommodate the growing influence of AI in innovation [78][73].
- Establish a dedicated oversight body within the Ministry of Commerce and Industry to ensure that AI-inventorship patents are properly managed and comply with ethical standards. This oversight would be essential to maintain the integrity of the patent system as it adapts to new technological realities [78][73].

**5. Collaboration with International Bodies:**

- India should collaborate with international patent offices, such as the United States Patent and Trademark Office (USPTO) and European Patent Office (EPO), to align AI-inventorship standards and practices. This would help Indian patents gain international recognition and improve cross-border protection for AI-driven innovations [78][73].
- Engage with the World Intellectual Property Organization (WIPO) to adopt global best practices for AI in intellectual property. Such engagement would facilitate the sharing of knowledge and experiences, enhancing the effectiveness of India's legal framework [78][73].

**6. Monitoring and Evaluation:**

- Set up mechanisms for monitoring and evaluating the hybrid inventorship model. This could include regular audits of AI-related patent filings, feedback from industry stakeholders, and an annual report assessing the impact of the new system on patent filings and innovation output [78][73].
- Feedback loops from industry leaders, inventors, and the IPO could be integrated into ongoing legislative adjustments to ensure the system remains flexible and responsive to technological advancements. This adaptability is crucial for maintaining the relevance and effectiveness of the legal framework in the face of rapid technological change[78][73].

## 5.2 Policy Recommendations

**1. Legal Reforms:**

- Expand the definition of "inventive step" under Section 2(1)(ja) to allow for AI-generated non-obviousness, ensuring that innovations derived through AI are adequately protected. This change would facilitate the patenting of AI-generated inventions and encourage further investment in AI research and development [63].

**2. Training Programs for Patent Examiners:**

- Establish mandatory training programs for patent examiners to improve their understanding of AI and other emerging technologies. These training programs should focus on how AI contributes to the invention process and how to assess patent applications that involve complex AI-driven innovations. Such educational initiatives are essential for ensuring that examiners are equipped to handle the unique challenges posed by AI inventions [60][58].

**3. Public Awareness Campaigns:**

- Launch public awareness initiatives aimed at educating inventors, businesses, and policymakers about the role of AI in innovation and the necessity for legal reforms. This could involve partnerships with industry groups, academic institutions, and technology incubators to raise awareness about AI's potential impact on patent filings and the broader economy. Increased awareness can foster a more supportive environment for AI-driven innovations [60]

#### 4. Enforcement Mechanisms:

- Strengthen the enforcement of patent rights in India, particularly for AI-driven innovations, by improving the efficiency of the judicial process. This could include setting up specialized IP courts to handle complex cases involving emerging technologies like AI, thereby reducing delays and ensuring faster resolution of disputes. Efficient enforcement mechanisms are vital for protecting the interests of inventors and promoting innovation [63].

### 5.3 Industry Impact

The implementation of a hybrid inventorship model could have profound effects on several key industries:

#### 1. Pharmaceuticals:

- AI is already playing a significant role in drug development, helping to design new molecules, optimize clinical trials, and predict patient outcomes. Recognizing AI as a co-inventor in this sector could accelerate innovation, attract global investments, and position India as a leader in AI-driven pharmaceuticals. AI contributions in the pharmaceutical sector could also reduce the time-to-market for new drugs, making Indian firms more competitive internationally [71].

#### 2. Agriculture:

- AI systems are transforming Indian agriculture by improving crop yields, reducing the use of resources like water and fertilizers, and developing new methods for sustainable farming. Acknowledging AI's role in inventorship could lead to an increase in patent filings for AI-driven agricultural technologies, helping India address critical issues like food security. For instance, AI-powered drones that can monitor crop health or AI algorithms that optimize planting schedules would generate patents that could be formally protected under the new model [71].

#### 3. Information Technology:

- The IT sector, where AI is deeply integrated into everything from cybersecurity to data analytics, stands to benefit significantly from the hybrid model. Recognizing AI contributions could spur more innovation in AI-driven technologies like machine learning and cloud computing, further boosting India's position as a global technology hub. This recognition could lead to increased investment and collaboration in the IT sector, fostering a vibrant ecosystem for technological advancement [71].

### 5.4 Challenges and Solutions

#### 1. Challenge: Resistance to Legal Reforms

- Solution: Engage in public consultations with stakeholders, including legal experts, inventors, and AI industry leaders, to build a consensus on the need for reform. Offer incentives for businesses that adopt the hybrid model early, encouraging broader acceptance. This collaborative approach can help mitigate resistance and foster a supportive environment for legal changes [60].

## 2. Challenge: Ensuring Ethical AI Use

- Solution: Develop strict guidelines for transparency in AI-driven innovations, including requirements for documenting how AI systems were trained and how their decisions were arrived at. This could mitigate risks of bias or unethical AI usage, particularly in sensitive fields like healthcare. Establishing clear ethical standards is essential for maintaining public trust in AI technologies [60].

## 3. Challenge: Training and Expertise Gaps

- Solution: Partner with academic institutions and global patent offices to design comprehensive training programs for patent examiners. Provide continuous education opportunities to keep examiners up to date with the latest advancements in AI and related technologies. This ongoing education will ensure that patent examiners are well-equipped to evaluate AI-related inventions effectively [60].

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## 3. Conclusion

The hybrid inventorship model presents a forward-thinking and legally viable approach to addressing the challenges of AI-generated inventions. By recognizing AI as a co-inventor alongside a human counterpart, India can adapt its patent system to the evolving landscape of innovation without compromising on the essential principles of human accountability and ethical oversight. Summary of Key Points:

- India's current patent laws, rooted in the Patents Act of 1970, do not account for the contributions of non-human inventors, creating a gap in the recognition of AI-driven innovations.
- The hybrid inventorship model proposes AI as a co-inventor while ensuring that human inventors retain full legal and ethical responsibility for the AI's contributions.
- Legal reforms, including amendments to the Indian Patent Act and updated guidelines for patent examiners, are essential to make this model operational.
- This model would significantly impact AI-driven sectors such as pharmaceuticals, agriculture, and information technology, driving increased patent filings and fostering greater innovation.
- Ethical considerations such as accountability, transparency, and bias must be carefully managed to ensure that AI's integration into inventorship does not lead to unintended consequences, especially in sectors affecting vulnerable populations.

Call to Action: The recognition of AI as a co-inventor is not just a legal necessity; it's a step toward ensuring that India remains competitive in a global economy increasingly driven by AI and emerging technologies. Legal reform is essential to creating an innovation-friendly environment that encourages growth, particularly in industries critical to India's future. We encourage policymakers, legal experts, and industry leaders to collaborate in shaping this new framework. By actively participating in public consultations, pushing for necessary amendments, and supporting pilot programs, stakeholders can help drive the transformation of India's patent system. Moreover, staying informed about AI's role in innovation and its implications for intellectual property will enable individuals to contribute to this evolving conversation. In conclusion, AI-driven innovation represents a key opportunity for India to close the gap with global leaders in technology and patents. The hybrid inventorship model offers a balanced, ethical, and legally sound pathway to capitalize on this potential, making India a front-runner in AI-led advancements while safeguarding inventorship principles and ensuring that human oversight remains central.

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