CRIME FORECAST USING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING: PERSPECTIVES AND CHALLENGES

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Abstract

The functionalist school sociologists contends that crime is inevitable to the society and it cannot be avoided. There is a proportional relation between crime and society as crime advances with the society development. From the numerous recent changes ongoing in our legal system, it can be easily inferred that an act which was not considered as crime, might be a crime today and an act which was considered as crime, might not be a crime today. With time and technology, there is not only increase in conventional crimes but also varied and different categories of crimes. These advancements in criminal activities must be effectively dealt by our legal system. On the other hand, in 21st century, we are also witnessing the fast-paced technological advancement, overhauled by involvement of Artificial Intelligence and Machine learning. Its usage is also growing at exponential rate in everyone's routine whether it may be an individual or an organisation. AI and Machine Learning are so-called advanced that they can predict the upcoming circumstances based on the algorithms and data available. This feature is sometime reasoned to enlarge effectively enough so as to predict the crime and prevent the occurrence. Keeping in view the continuous rise in crimes, can it be a prefect tool to avert the crime from happening? The authors in this paper have identified the practicalities of system using machine learning technology by furnishing perspectives and challenges. The paper essentially centres around the differences between the traditional approach and emerging practices through involvement of AI and machine learning in dealing with crime and its impact over the individuals as well as society.

Keywords: Artificial Intelligence, Machine Learning, Fundamental Rights, right to be Forgotten, Criminal Laws.

"It is not a difficult computer science problem but a difficult social science problem."

- Jen Ludwig

I. PROLOGUE

We as human are witnessing several changes around us. We are developing, discovering new knowledge now and then which one way or another helps us and society. We had seen the dawn of technology as well as dusk of old practices. New technologies dwindle the old practices including traditions and values which were once most-cherished among people.

With the growth of the mankind, the technology also gradually progressed and its usage escalated. Discovery of wheel, formation of tools to hunt etc. used by early humans are key examples of first use of technology. From that day, the technology and its usage has emerged in innovative forms on unvarying basis covering almost each aspect of our life. More importantly, by regular update and upgradation, technology has enhanced itself with the time.

Another example of such time-changing concept is nature of crime. Many functionalist school sociologists argue that crime is inevitable to the society and it cannot be avoided.[1] It will create itself within the society according to the societal structure. As time has changed so does the notions of crime too. Nevertheless, time to time, we need to cover the gap formed by the lack of crime identification, otherwise it will lead to an undesired consequence which might impact the whole society. Likewise, with the unprecedented rise in numbers of crime, there is high need to control the upsurge.

In the 21st Century, the technology is led by the involvement of Artificial Intelligence and Machine Learning in our daily life. Almost every new device, gadgets, digital assistants, search engines, store and services etc. are using it in best manner possible to simplify the experience of a person. This intensive growth can be detected by the fact that AI bumps into every human activity. Based on the human interaction with device, AI self-analyse the patterns and features with the help of algorithm it is programmed. It had the capacity to develop extra expertise on the substance of data processing and interaction. Another concept of Machine learning, based on artificial intelligence stance, focuses upon the computer algorithms and data. Machine learning has the capability to imitate intelligent human behaviour centred upon the available data and computer algorithms.[2]

[1] Durkheim, E. (1982). *The Rules of Sociological Method*. The Macmillan Press, New York.

[2] Brown, S. (2021). Machine learning, explained. *Ideas to Matter – Artificial Intelligence*. MIT

Though both AI and Machine learning are used synonymously, there is a thin line difference between both of the concepts. AI can easily reflect the traits of a human being by doing an act as it is programmed to do so, while Machine learning is so advanced AI-based technology that it identifies anomalies and can predict the outcome or possible future events even before occurrence and can act as per the event requires. Machine learning permits the system to automatically learn from previous data and information even though it is not programmed specifically. AI makes the device human-like, while machine learning enhances the functioning of machines on the basis of large data. These characteristics are sometime reasoned to enlarge effectively enough so as to predict the crime and prevent the occurrence on the basis of data gathered from general public.

Through this paper, the authors attempt to presents the different perspectives and challenges of predictive justice by AI and Machine Learning and its impact over the society. Current research study shall be discussed in five parts. The first part shall be the introduction, where the researcher shall be presenting the general outlines of the subject. Second part shall be devoted to ongoing practices at the international level, where the authors shall be making the discussing the use of AI and machine learning in forecasting crime. Third part shall be a focusing upon the difference between traditional practices under criminal law and emerging practices through the use of AI. Fourth part shall be detailed analysis of predictive justice. Fifth part will be dealing with the challenges in implementing the crime forecast system. Sixth part will be the final part where the authors shall be summarising the discussion.

II. CRIME FORECASTING PRACTICES:

INTERNATIONAL FRAMEWORK

At the international level, the use of artificial intelligence and machine learning in forecasting the occurrence of crime was firstly performed by the developed countries. Initially, it was installed by United States through National Institute of Justice and then with time in United Kingdom, Germany, Switzerland and the Netherlands. In 1998, United States NIC granted 5 grants for forecasting the crime which are now improvised considering the rate of crimes.[3]

Management Sloan School. https://mitsloan.mit.edu/ideas-made-to-matter/machine-learning-explained.

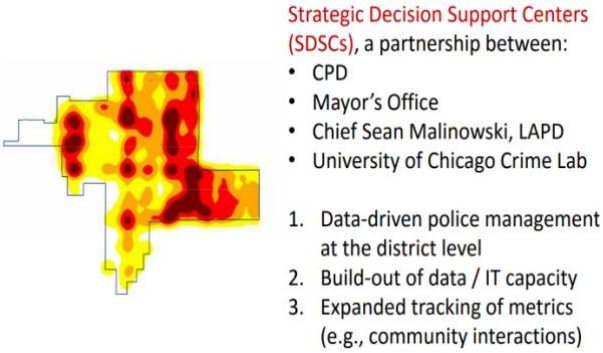
[3] Rummens, A., & Hardyns, W. (2017). The use of predictive analysis in spatiotemporal crime forecasting: building and testing a model in an urban context. *Applied Geography,* 86, 255–261. https://doi.org/10.1016/j.apgeog.2017.06.011.

Similarly, few of the other models are also operational in several parts of the world.

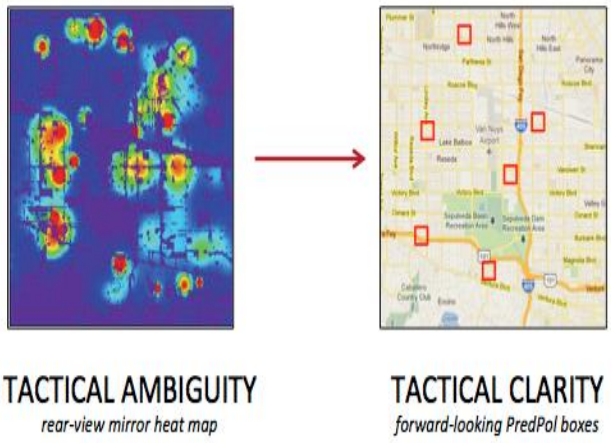
SDSC (Strategic District Support Centre) by Chicago Police is a Geo based mapping system provides situational awareness crime forecasting software identifies areas that are most at risk for violence and gunshot detection sensors enable officers to respond more. Source: Urban Labs, University of Chicago[4]

The data analyzation depends on the previous occurrence of similar offence. An offence was committed earlier is entered into data system and then accordingly, machine learning predicts the next occurrence. A similar person-place prediction approach is taken in Los-Angeles. Moreover, all of the residents in that area were under continuous surveillance and points are given on the basis of chronic offender bulletin, a measurement scale system which gives points for every act. Thus, every person is scaled in terms of numbers and higher the number, the higher are the chances that he committed the offence.

PredPOL (now known as Geolitica) is a location based Proactive Policing machine learning which analyse the place where



crime occurred and then predicting the next possible place of occurrence in future.[5] At present, it is being used by the police in Kent State, United Kingdom, China, Denmark and several states of the United States.[6] It aids the police by giving the next location of crime,



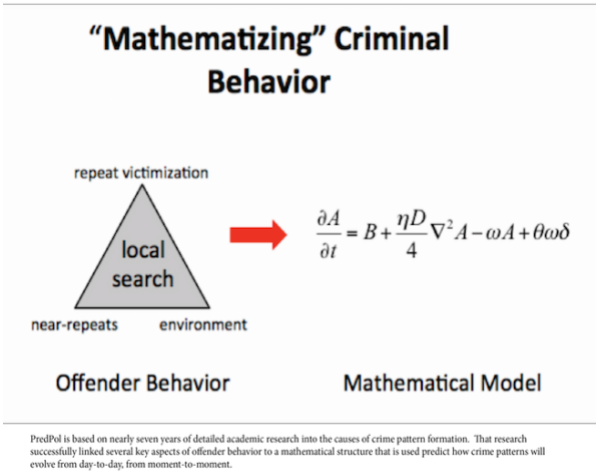
so that the police will present there to prevent the occurrence. This program was previously used by United State Police, tried in

[4] Ludwig, J. (2022, Feb 02) *Crime in Chicago: Beyond the Headlines*, UrbanLabs Crime Lab, University of Chicago. https://urbanlabs.uchicago.edu/attachments/c83b0a5180de9f7fec83d5ffdaa75fa6a9233a38/store/a307ce9c99429b8e276b2fa982ce2df90a44f1207258a7c1ca95914f1342/city+club+Jan+2018_FINAL.PDF.

[5] *Predictive Policing: Guidance on Where and When to Patrol*. PredPOL. https://www.predpol.com/how-predictive-policing-works/.

[6] Friend, Z. (2013). Predictive Policing: Using Technology to Reduce Crime. *FBI Law Enforcement Bulletin*. Federal Bureau of Investigation. https://leb.fbi.gov/articles/featured-articles/predictive-policing-usingtech nology-to-reduce-crime.

California which decreased the rate of crime occurrences upto 12 percent in general and 27 percent in burglary cases. With support from the National Science Foundation, a team at UCLA developed PredPOL, a set of algorithms for predicting where crimes will occur.



Source: PredPOL[7]

According to Dominic Choi[8], the program creates a 12-hour map which predicts the next crime place and then accordingly policemen are placed nearby that space. During police patrolling, it was observed that this machine learning technology was about 25-30 percent accurate. According to Prof. Dr. Jeffery Brantingham[9], the PredPOL considers three aspects of Mathematical Model to arrive at conclusion and these are (i). Environment (ii). Repeat Victimization and (iii). Near Repeat Victimization. He added further that every aspect of human behaviour, related to criminal justice can be consider as factor. [10]

Analytikus program is currently used by the Mexican government in Nezahualcóyotl city. This city, divided in 10,950 blocks, is one of the most densely populated cities in Mexico. Today, it is recognized as safe place because of the improved security conditions. They had installed Proximity Police Analytikus software by which they analyse the citizens' data and gathered information about all persons.[11] According to Lic. Jorge Amador[12], due to this technology, they had also witnessed the decrease of corruption among the policemen. The result generated is more favourable to society. The machine learning used by them processes the information of more than 300 patrols, neighbourhoods' society networks.

[7] *What PredPol is and What PredPol is NOT*. PredPOL. https://www.predpol.com/ whatispredpol/.
[8] Assistant Chief, LAPD Command Staff. He is also the first Asian American Assistant Chief.
[9] Chief of R&D, PredPOL and Professor at UCLA (University of California, Los Angeles).
[10] Saunders, F. (2016). First Person: Andrea L. Bertozzi and P. Jeffrey Brantingham. *American Scientist, 104(5)*, 264. https://doi.org/10.1511/2016.122.264.
[11] Cortes, A.L., & Silva, C.F. (2020). Artificial Intelligence Models for Crime Prediction in Urban Spaces, *Machine Learning and Applications: An International Journal* 8, 1-13. https://aircconline.com/mlaij/V8N1/8121 mlaij01.pdf.
[12] Managing Director of Citizen Security Nezahualcóyotl, Mexico.

Risk Terrain Modelling, projected by Joel M. Caplan[13] and Leslie W. Kennedy[14] took a different methodology by forecasting crime through risk assessment approach. They had included several map layers and other essentials of risk factors in a geographical information system and showed its effect in trategic decision-making and tactical action of human beings. These geographical conditions factors mould the human nature and can easily predicts the crime.[15] They firstly enlisted all of the factors and contended that such factors vary from person to person and more importantly place to place. In such routine, these factors on the basis of mindset forms can predict the crime or different types of crime. There will be different configuration for every scenario and therefore intervention need to be tailored accordingly.

III. Core Principles of Criminal Laws vs Rigid AI and Machine Learning

Every new technology somehow vicissitudes the human experience as well as behaviour. Same is the case with AI and Machine Learning, it is changing the human's experience when it is used in mobile applications, streaming platforms, online website etc. They are programmed to learn and reflect what user wants. But this stance is rather different when it is applied to forecast crimes. It has the tendency to supersede the core principles of criminal laws.

Penal laws follow strict legal interpretation and majorly revolve around the principle of *actus reus* (physical acts) and *mens rea* (mental element). Though there are few exceptions, it differs also on the facts and circumstances of the case. However, these both elements can only be inferred when there is commission of crime, as both elements had the capacity to change the human mind even right before the execution or committing the crime. Now when we

[13] Professor at Rutgers University School of Criminal Justice and Deputy Director of the Rutgers Centre on Public Security.

[14] Professor at Rutgers University.

[15] Caplan, J.M. & Kennedy, L.W. (2010). *Risk Terrain Modeling Manual: Theoretical Framework and Technical Steps of Spatial Risk Assessment for Crime Analysis*. Createspace Independent Publications, California. See also Barnum, J.D. & Caplan, J.M. (2017). The Crime Kaleidoscope: A Cross Jurisdictional Analysis of Place Features and Crime in Three Urban Environments. *Applied Geography, 79,* 203-211. https://doi.org/10.1016/j.apgeog.2016.12.011.

consideration before arriving at conclusion in order to contemplate as if do we require the predictive justice technology?

1. **Law as a System**

   Law as a system deals with almost each and every aspect of an individual and society. It focuses upon crimes, constitution, contracts, business and even every act of human being. It is sought to be the best means to achieve the ultimate goal of welfare society. Law can be perceived as the reflection of societal needs. Our society plays a crucial role in shaping the laws as if what shall be permissible and what shall be not permissible. It doesn't remain constant, rather it keeps on changing and altered as per the requirements and needs of the society. Because of this, it can be inferred that law is not perfect rather it has to be brewed in such manner to accomplish the trending needs of the society. If there is rise in crime statistics, the law had to be drafted in a manner to cover all emerging dimensions. At the same time, the law shall also uphold the basic fundamental principles protecting the individual and the society.

2. **Need for Technology**

   The technological advancement used by the offenders in the crime commission necessitates a strong counter measure in order to deter the offender. The law shall always be a step ahead in technology to offset the rising crimes and to punish the offenders accordingly. However, machine learning takes a different approach by forecasting the offence even before commission which creates an ambiguous situation. This can be easily understood by example of cybercrimes i.e. The law enforcement requires advanced technology to apprehend the person committing offence in cyberworld, not before the commission of crime.

3. **AI, Machine Learning and its implementation**

   From international framework of this technology, it can be inferred that AI and Machine Learning has been already implemented in few cities and states across the world and mostly in developed western countries. The implementation and its effect are yet to be observed in the developing and third world countries where more numbers of crime take

place. Prof. Andrew G. Ferguson[16] contended that this type of policing system, doesn't violate the Fourth Amendment of the US Constitution, rather it perfectly fits within the old traditional laws and emerging laws.[17] He further added that such technology will have a significant effect based on reasonable suspicion data analysis.

In a survey conducted by Dr. Hany Farid[18], he concluded that hiding behind big data and data analytics, AI and machine learning, we give the appearance that the predictive algorithms are making more sophisticated algorithms than they actually can. It appears as if they can predict the future while in reality, they are actually doing something very simple. Dr. Farid took assessment of random 400 people's decision skills judging the criminal cases by providing few sentences of the fact and no other factors to consider including race and ethnicity. As a result, the people's poll and data produced by machine learning was much similar in nature having a diminutive difference.[19] Thus, he questioned that if we as human are capable to produce same result, why do we need machine learning? The technology has to be someway better than what we are now, thus AI comes into picture which segregates the data and create a difference between both sects. He also added that, it would be dangerous and reckless to unleash predictive algorithm without thoroughly understanding.

The science of developing AI and Machine learning follows the principle of introspection. We, as human beings introspect ourself and then try and program the computer to do exactly the same thing through data-driven approach. The difficult task is not to collect the data, it is to test the algorithm and place the prejudice upon the people. The machine learning technology which we are using now is in self-contained online environment, while its application in public policy will much more often complicated. More importantly, we had to assess that are these algorithms better than us? We presumably make data for more accurate result and to remove any possible biasness that may exist.[20]

V. CHALLENGES

[16] Professor of Law at American University Washington College of Law.

[17] Ferguson, G. (2012). Predictive Policing and Reasonable Suspicion. *Emory Law Journal, 62,* 259.

[18] Dean and Head of School for the UC Berkeley School of Information.

[19] Dressel, J. & Farid, H. (2018). The accuracy, fairness, and limits of predicting recidivism. *Science Advances,* 4(1), 5580. https://www.science.org/doi/10.1126/sciadv.aao5580.

[20] Ludwig, J., & Mullainathan, S. (2021). Fragile Algorithms and Fallible Decision-Makers: Lessons from the Justice System, *National Bureau of Economic Research Working Paper No. 29267*. https://www.nber.org/system/files/working_papers/w29267/w29267.pdf

As the other side of Perspectives, there are also few challenges present before Machine Learning and AI to forecast the crime. Few of the challenges are enlisted as:

1. *To deal with the concept of speedy justice:* The purpose of implementing Machine Learning program as a part of policing is to enhance the policing ability, predict and prevent the crime before the incident takes places. The designed programs are no doubt time-efficient in nature but does it consider all of the circumstances lying around the person accused? The concept of speedy justice is not focused on time efficiency rather to deliver justice in timely manner. Moreover, convicting persons even before crime will infringe his basic human rights.

2. *To deal with variety of crimes:* The use of machine learning program might be useful in few similar cases, but it will fail to deal with variety of crimes. It has been already witnessed that with change of time, the crime also varies and even laws become to cover that loophole. In such scenario, it would be difficult for human developers to predict the usage of such program in assortment of cases.

3. *To deal as per the complex procedural laws and surrounding facts:* The AI and Machine learning takes into consideration the data which human being provides and on the basis of it they evaluate the possible circumstances. Sometime, the nature of procedural laws is still complex enough for the adjudicators that they fail to seek clarity over it and seeks advice of above hierarchal courts. In such scenario, how can we rely on a machine which is simply based on algorithms premeditated by a human. The courts while deciding the judgments always emphasis that facts and circumstances of a case is not always necessarily similar to precedents followed, every case is unique in its own way. While the machine learning program will always analyse with the help of data available to it and there will be higher chances that it will not consider the new circumstances took place.
4. *To deal with ethical and policy issues:* Though the data processing level of analysis used in several sectors proved out to be beneficial, it faces ethical issues. Moreover, most of the ethical issues not only related to ethical usage but to rules and legislation accompanying. The lack of transparency, illegal use of such

programs, non-transparency, security difficulties etc. are few examples.

5. *Issues related to Data mining and right to privacy:* The data mining technology is used by many online platforms, specially on consumer platforms, where it assesses the human previous behaviour and predict the possible outcome he possibly wants. Such practices raise the concern related to privacy rights of the consumers and users. In addition to it, this collected data is sold to third parties without the consent of the users. Depending on this crucial data and information, market also drifts accordingly. Here, the major concern is not about the market variation, but the violation of fundamental basic rights. The machine learning technology requires data to be fed, which follows much similar outlines as violation of basic rights.

6. *Right to be forgotten:* It is one of the recent emerged dimensions from right to privacy. This issue can be easily understood by an Indian Case, *Jorawar Singh Mundy* v. *Union of India*[21], where the petitioner knocked the court's door to seek an order for removal of judgment mentioning his name from online websites displaying that judgment. In another case of *Jaideep Mirchandani & Anr*. v. *Union of India & Ors*.[22] , the Respondent has enlightened that the right associated with privacy also comprises of right to be forgotten. For the successful implementation of Machine learning, right to be forgotten will be the biggest road-block which has established its root deep down in fundamental rights. If there will be no data to input, the calculation task of machine learning program would be based on vaguer foundations.

7. *Prone to Damage and vulnerable to attack:* So far, all of the machine learning program installed depends upon the ascertained factors for evaluation. These factors are very much subjective is nature, which might be hard to assess. The inclusion of one factor and exclusion of another factor can substantially alter the result. In such scenario, it will be too dangerous to punish a person on the

[21] Writ Petition (Civil) 3918/2021, Delhi High Court, India.

[22] Writ Petition (Civil) 12620/2021, Delhi High Court, India.

basis of faulty data. Furthermore, these programs are vulnerable to attacks by the way of hacking. If hacked, the hacker can modify or alter the basics of the assessment which will have a great impact on human lives. In such circumstances, promoting the machine learning without proper check would be similar to humiliating the human lives.

8. *Issues about accuracy:* The outcome of the machine learning programs installed so far, is in percentages and highly based upon probability method. Even the programs are not sure as if the crime will occur or not. If this remains the case, the machine learning program in a crime affected area, will always predict it more than 50%. This sets a prejudice that such area cannot be developed and will always remain a crime-hub. Even the PredPOL program predicts near about 30% probability that crime will occur next at a place.[23] In light of it, the question of accuracy gives more hostility to men supporting this concept.

9. *Increase in discrimination:* Instead of looking toward better future, it mirrors social existing social inequalities. The installed programs predicted outcome based on race biasness because we are feeding data as we have and the old data is nowhere taking to better future rather holding us on a same stance. In the western countries, where the program is installed, it was observed that the program favoured white skinned people more than black people. There are higher chances that the program will try to implicate what we followed till now and not how we can make society better.

VI. EPILOGUE

The lucidity behind implementation of forecasting crime even before occurrence seems a humble approach to prevent the crime rate, but at the same time it also oversteps several rights and practicalities. We want that all of us including law enforcement to be technologically advanced but not on the cost of fundamental rights. From time to time, the law enforcement has also employed several technologies to counter-measure the crime, but the use of machine learning seems suitable to self-contained online environment only, while its

[23] Supra Note 7.

application in public policy is much more often complicated.

One of the major limitations of machine learning in crime forecast could be the use of deduction method, which highly relies on the inputs. This creates a condition where the outcome can only be relied if the data fed to the program is true or not flawed. Here, rather than to improve the society we are placing prejudice against the individuals based upon few precedents and it does not let us move forward and keeps us tied in one place. By going as per forecasting method, we are left with nothing to improve the criminological aspects of the society as we will be dragging on the old crimes rather than focusing on the other circumstances helping the society to progress. Furthermore, the forecasting highly relies on factors which are nothing but the quantifiable data. Considering the diverse civilizations and ethnicity in different parts of the world, it will be very difficult to assess the all forms of emotions and mental state of mind in limited factors. Not everything can be structures into factors or mathematical values.

A much-similar approach was taken by Cesare Lombroso, an Italian criminologist, through biological theory of crime whereby he identified biological factors which leads a person to commit the crime, though there were no casual evidence to rely on. This theory was heavily criticised on the foundation that it completely ignores the other surrounding factors which may prevent him. In the case of Machine learning program, the programmer ascertains few factors which scale a person in terms of crime data fed to it and leaves no gap for other components which might prevent the individual from committing the crime.

By implementing this technology, are we near to annihilation of humankind by AI and Machine Learning? The answer lies with the results and progress of the technology. Just because it processes data on high level and provide outcome, it cannot be assumed that it will be always correct. Even one little misuse can ruin the fundamentals of criminal justice system. It is good that we are growing with the technological advancement, but it shall not be used as curse against the individual and society. Thus, placing too much trust on this technology can be detrimental. Technology can be a force for tremendous progress and tremendous good but if it is left unchecked it will plunge us into a digital cacotopia.