

# Survey on Blockchain-based Anonymous Tip-off System

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**Abstract:-** This Survey Paper entails detailed research on all possible solutions for a crime witness to be able to submit crime tips, while staying anonymous. In present times, crimes are increasing at a high rate and so is the technology which is used to tackle them. However, even to this day, throughout the world, most people who witness crimes don't come forward to report them due to fear of getting into unnecessary procedures and interrogations. The aim of our project is to promote the social responsibility of citizens to come forward and talk about crimes they have witnessed, without having to fear repercussions. Our application also aims at rewarding these anonymous tip providers to increase their participation. We are also making crime documentation easy and cost effective by using decentralized means of storage with the help of Blockchain. This not only keeps information safe but also reduces cost on servers. In addition to this, we are utilizing Machine Learning and NLP to be able to auto categorize crimes along with ensuring genuineness by checking for morphed image submissions, thus reducing user's effort. Apart from being a user-friendly application, our platform is very essential to Crime investigators, especially for undercover agents who work on the basis of insider information. This app helps in gaining clues and have prior knowledge of extremely dangerous crimes like terror attacks or bomb blasts which could pose national threats.

## I. INTRODUCTION

This Project is named as 'Anonymous Tip Off' which is a blockchain based Anonymous Tip-off System. Crimes like harassment and abuse often go unreported due to hesitation or due to pressure from higher authorities. Even Crime witnesses have a fear that they might get exposed if they report a crime. We are building a mobile application that is committed to providing an effective, anonymous tip-line system. It does not just ensure anonymity but also promises

confidentiality. It provides intelligence and information to local agencies relating to criminal activity obtained from the tip description.

## II. LITERATURE SURVEY

The paper "Blockchain-Empowered Mobile Edge Intelligence, Machine Learning and Secure Data Sharing" published on March 12<sup>th</sup>, 2021 by - Zehua Wang, Yao Du, Shuxiao Miao, Victoria Lemieux, which focused on resolving complications involved in combining blockchain and Machine Learning. They highlighted the concept of 'Proof of Work' mechanism which relies on the success of mining mechanism and increasing the hash rate to make NFTs more resilient to attacks.

The paper written by Nhan Cach Dang, María N Moreno-García and Fernando De la Prieta which is - "Sentiment Analysis Based on Deep Learning: A Comparative Study" talks about how deep fake algorithms have made online media content non-trustable. It also states the effects on the efficiency of sentiment analysis which is due to challenges encountered in Natural Language Processing. Combining sentiment and semantic features, the main objective of the experiments conducted is to compare and weigh the performance of deep learning techniques to improve analysis results. The paper was published on 14<sup>th</sup> March, 2020 under the topic 'Artificial Intelligence'.

Lastly, a deep-dive into "A Study of Text Classification Natural Language Processing Algorithms for Indian Languages" published in July, 2015 by Jasleen Kaur and Dr. Jatinderkumar R. Saini revealed how expansion of social media has resulted in usage of different kinds of languages on the internet. This adds complexity to Text classification task. This paper provides the analysis of various text classifiers which can work effectively on Indian Languages.

Author & Publication Details	Problem Focused	Techniques	Performance	Outcome
<p><b>"Blockchain-Empowered Mobile Edge Intelligence, Machine Learning and Secure Data Sharing"</b> - Zehua Wang, Yao Du, Shuxiao Miao, Victoria Lemieux, published on March 12th, 2021</p>	<p>Complications in combining Blockchain &amp; ML. Powerful microchips required for ML Algorithms to run, making Data more secure and less accessible to just anyone</p>	<ol style="list-style-type: none"> <li>1. Proof-of-Work (PoW Consensus Algorithm)</li> <li>2. Permissioned Blockchain network</li> <li>3. Zero-knowledge proof and zk-SNARK (Proof that allows a prover to prove the knowledge of a secret to a verifier without revealing it)</li> </ol>	<p>PoW mechanism relies on the success of mining mechanism. The higher the hash rate is, the more resilient the NFT is against attacks.</p>	<p>With security and privacy-preserving features, blockchain could be an effective solution to secure the aspects of data sharing and resources allocation in AI applications, especially for mobile edge intelligence.</p>
<p><b>"Sentiment Analysis Based on Deep Learning: A Comparative Study"</b> - Nhan Cach Dang, María N Moreno-García and Fernando De la Prieta, published on 14th March, 2020</p>	<p>Usage of deep fake algorithms have made online media content non-trustable, thus using sentiment analysis to filter factual content. The efficiency and accuracy of sentiment analysis is being hindered by the challenges encountered in natural language processing (NLP)</p>	<ol style="list-style-type: none"> <li>1. Deep Neural Networks (DNN) and Convolutional Neural Networks (CNN)</li> <li>2. Feature Extraction</li> <li>3. NLP</li> <li>4. Tensorflow libraries for tests</li> </ol>	<p>The effectiveness of the algorithms depends largely on the characteristics of the datasets, hence the convenience of testing deep learning methods with more datasets in order to cover a greater diversity of characteristics.</p>	<p>Combining sentiment and semantic features The objective of the experiments is to compare the performance of these deep learning techniques, contributing the state-of-the-art literature on sentiment analysis tasks.</p>
<p><b>"A Study of Text Classification Natural Language Processing Algorithms for Indian Languages"</b> - Jasleen Kaur and Dr. Jatinderkumar R. SAINI, published in July, 2015</p>	<p>India, being a unity in diversity, consists of many languages used for verbal and written communication. For easy retrieval of digitized documents containing Indian Languages, these documents must be classified into a class according to its content.</p>	<ol style="list-style-type: none"> <li>1. Naive Bayes Algorithm (NB)</li> <li>2. Support Vector Machine (SVM)</li> <li>3. Artificial Neural Network (ANN)</li> <li>4. N-gram</li> <li>5. Text Classification is an area of Text Mining which helps to overcome challenges in document retrieval.</li> </ol>	<p>After pre-processing and feature extraction the important step of text classification, is feature selection to construct vector space, which improves the scalability, efficiency and accuracy of a text classifier.</p>	<p>Expansion of social media leads to usage of different kinds of languages on web. This adds complexity to Text classification task. This paper provides the analysis of various text classifiers which work on Indian Languages.</p>

Table 1. Shows Techniques Used and Outcomes of the papers published

### III. PROBLEM

#### A. Problem Identification & Background:

According to statistics, the crime rate in India from the year 2019 to 2020 was 383.3 per lakh population and 487.8 in the following year. Only **6-8%** of victims of theft, sexual assault and other crimes in major Indian cities lodged a first information report (FIR) with the police, according to a new study in 2021. The **92-94%** who remain are not reflected on any possible records. The question is, why are these crime numbers so high and people who report the crimes so low?

It is an extremely difficult task to solve crimes and the law enforcement community often faces many challenges. There are several factors that can limit the efficiency and

performance of the police, out of which, the most important factor is the ability of witnesses and callers to provide reliable information about the suspect's identity and actions. Without this basic information from people who know about the crime incident, solving a crime becomes extremely difficult.

There may be a number of reasons why people hesitate to come forward and report crimes, some of them include the following:

- People do not trust the police. Before reporting any incident to the police, people think their own circumstances will be investigated too.
- Dealing with police officers is tedious and not easy to go through. They repeatedly contact the person who reports

- the crime and some may find it as being too much of a hassle.
- Being in fear of the consequences. Even when the law enforcement officers state that they will keep names anonymous, one’s name is still on the records and can easily be seen or gained access to.

- Traumatization caused by the crime makes some victims and sometimes, even witnesses, not want to think about the crime.

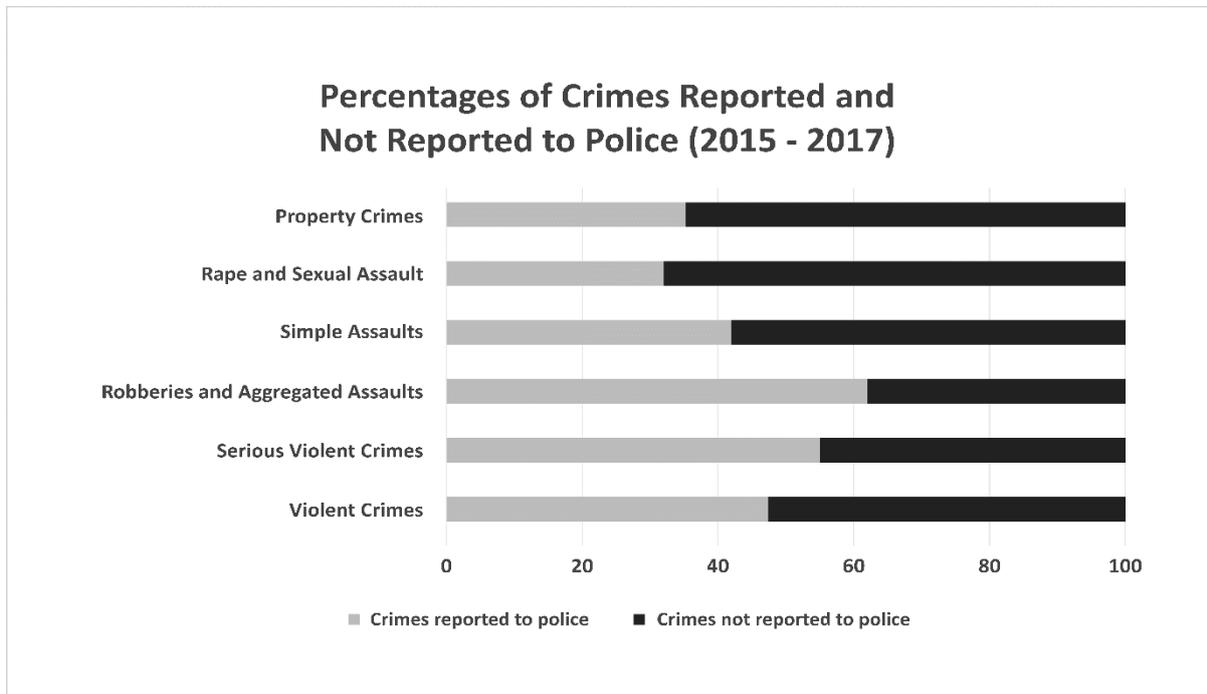


Fig 1. Statistics from 2015 to 2017, showing percentages of crimes reported and not reported to police

Throughout the world, most people that don’t come forward to report crimes due to fear of getting pulled into unnecessary procedures. Others don’t report more serious crimes, if they are just witnesses at the scene. They would prefer to avoid going to court and having to testify or putting themselves or their families at risk. In most cases, women are afraid to report crimes like domestic violence and harassment in their homes because they have or feel like they have no other options to get out and make it on their own.

The reporting of crimes does not just depend on the crime but on the witness or victims’ location, gender, age and status as well. In his article “*Crime Reporting Behavior: Do Attitudes Toward the Police Matter?*” published in February 2016, Francis D. Boateng writes about studies that examine the determining factors of crime reporting, that are significantly influenced by victims’ demographic characteristics (Study Contributors: Acierno et al., 2001; Clay-Warner & Burt, 2005; Goudriaan et al., 2006; Hart & Rennison, 2003; MacDonald, 2001; Zhang, Messner, & Liu, 2007).

Research shows the effect of victims’ education, where highly educated victims are more likely to report a crime than those who are uneducated (Clay-Warner & Burt, 2005). Contradicting to this, some argue that victims who are less educated are more likely to report a crime (Goudriaan et al., 2006; Wolitzky-Taylor et al., 2011). Lizotte (1985) noted long ago that due to the fear of losing economic status, social

standing or their jobs for that matter, highly educated women who were sexually assaulted or domestically abused were often less willing to report their victimization to the police.

In other cases, the people do not know if they are supposed to officially lodge a complaint against a certain crime occurred or about to occur. Is it illegal if one does not report a crime? What should one do if the crime has already taken place, or if they believe it is about to?

The answer to this is that, in general, mere knowledge or suspicion that a crime has taken place doesn’t obligate a person to report it as a matter of law, with certain narrowly limited exceptions. It is one’s moral responsibility to report a serious and dangerous crime; however, if reporting the crime would pose a threat to the witness’ family or themselves, there can be an exception.

In general, there is no legal obligation to report a suspected plan or scheme to commit a crime in the future, provided you are not at all involved. With that being said, there are several ways in which a person is considered to be involved in the commission of a crime by, for example, being present at the scene, conspiring with the others who actually go on to commit the crime, hiding it, helping the criminal hide from the authorities, funding and financing it, and so on. In general, people such as friends or fellow gang members of the perpetrators or any one close who just happened to be around, may be brought in for questioning if they seem suspicious or

relevant to the scenario, and then given the opportunity to cooperate with police in giving their statement or testimony.

Talking about privileged relationships, some professionals such as principals, teachers, professors, doctors, therapists, etc., go through situations where they might find the need to break confidentiality, when the person they are obligated to is either planning to commit a serious, violent crime or is suspected to be going through abuse of any kind. We can also consider lawyers dealing with white-collar crime, such as securities fraud and tax evasion. There are other situations where banks might be obligated to report suspicious transactions under money-laundering statutes, etc.

In all of these cases, we observe that ‘Reporting’ a crime seems much more of a responsibility than just telling or talking to someone about what happened to you. So why isn’t there a system that lets people to do JUST THAT. Yes, there is without a doubt a way in India where you can report any crime anonymously and it will be acted upon if it contains actionable wrongs by the persons complained against. The Complaint must have facts and circumstances that clearly establish the crime(s) alleged or actionable wrongs worth verifiable. This can be done through phone calls, letters, mails, sms, etc. However even after so much advances in technology, to this day, there lacks any form of automation or single maintained application that can connect law enforcement and people, and verify if the crime reported is factually relevant. This to us, seems to be the biggest gap between crime victims and justice in the world.

#### B. Problem Statement:

We are building a system to anonymously submit tip-offs about a crime that has either already occurred or those about to occur, which would further help law enforcement officers gain insights about these criminals. We would design and develop a mobile application to give users an opportunity to pass on any crucial information they have regarding a particular crime they may have witnessed. This information would be directly handed to law enforcement side of the application, which will be used during investigation of this crime, while keeping the users who gave this information, completely anonymous. This not only helps in crime solving but also allows effective documentation of a crime.

#### C. Problem Scope:

The application we are about to build would be for two end-users, one being the law enforcement officers and the other being the witness of the crime.

Our main focus is:

- Maintaining Anonymity using Public Blockchain in addition to a ranking based tip-off system.
- Using parameters like user’s tip-off history on the blockchain, the system uses Timestamp, Location and Categories to prioritize reports and maintain anonymity of the Users.
- Usage of Smart Contracts with **ERC1155** based NFT for Anonymity and Proof of Identity.
- Implementing a failproof ranking logic to filter and prioritize Crime Incidents.

Implementation of the entire project would require a research period of about 2 months. Upon conducting adequate primary and secondary research, we would be moving on to the design and development phase. On an overall, a time period of ~1 to 2 weeks for design with a development time of ~2 to 3 months. The entire project is estimated to take an overall time period of ~5 to 6 months.

#### ➤ Goals and Objectives:

The goal of this project is to develop an anonymous tip-line for those users who are either afraid to come forward with proofs or because they might be bound by NDAs and confidentiality agreements. Such people have to go through injustice without being able to speak up about these crimes. Our motive is to promote social responsibility and increase citizen participation in fighting against crime. We want to bridge the gap between law enforcement and citizens to deliver justice. The main objectives of our project include:

- Ensure Anonymity of users who give tips about a crime
- To Increased Response from citizens
- Reward users who have given a valid tip
- Provide Better insights to law enforcement for Investigation
- Establishing a platform to access proofs and documentation of crime
- Reduce Paperwork
- Using NLP to auto categorize crimes, reducing manual categorizing for both law enforcement as well as witnesses

## IV. METHODOLOGY

We are using an advanced **ranking system**, wherein the user can submit their tip-offs with important details like time of crime, location, crime category as well as upload any images relevant to the crime. If the crime reported by the user turns out to be a genuine tip-off, the user’s rank would go higher. Similarly, in the case of a false tip-off, the user would go lower in rank.

We will be using NLP to analyze the description given by user and **auto-categorizing** the crime. This feature would allow law enforcement officers to filter out crimes based on priority. We also plan on integrating speech to text for tip description.

We will be setting up a **reward policy**, where in, the system tracks the user’s identity which has been converted into an **NFT** issued to their wallet and upon verification of whether the crime actually happened, this user would get rewarded and a certification for their good deed.

Further enhancements include - **Integrating Google Maps** onto the law enforcement application, where the user would get a graphical representation of the crime prone areas highlighted in red.

- When the user signs up, using the **Aadhaar eKYC** process, a unique token is registered based on KYC and an NFT is used for ‘**Proof of identity**’. We are thus reducing the user’s identity to a wallet address using

Blockchain Technology. In this way, the token can be used to identify and make sure they are genuine users.

- Once the user submits their tip using the Mobile App, this information reaches the law enforcement officers where it undergoes a number of processes.
- Further our system uses **Natural Language Processing** to analyze the given tip and auto-categorize crimes based on related keywords
- We would also be using **Machine Learning** to set rank of an event, based on the crime detected. For this we would be using parameters like location and time of crime, number of tips for same event and category of crimes.
- Finally, once the law enforcement officers conduct investigation to verify the tip, the system tracks the users submitting the tip using the wallet address. Based on if the tip was true or false, the user's rank goes higher or lower. This ranking helps in utilities like reward points and certification and further reports.
- As a precautionary measure, we will be using **sentiment analysis** to ensure detection of fake images and tips written in foul language etc. This is to handle fake reports from first time Tip submitters.

#### ➤ *Contribution to Society*

- This Anonymous Tip off system aims at increasing citizen's participation in fighting against crime. It promotes **social responsibility**.
- We are making our platform more accessible by building a mobile application to submit tips. Although there are additional requirements like internet connection and smartphones, our project is in support of the '**Digital India movement**'.
- Making crime documentation effective and cost-efficient by using a **Decentralized Storage** method, which not only keeps the information safe but also reduces cost on servers and means of digital storage.
- Giving essential insights is extremely useful for undercover agents and detectives who would be mostly associated with working on **insider information**. This application could act as a medium in solving extremely dangerous crimes which could pose national threats.

## V. CONCLUSION

The main take away from our survey is that it is very important to provide a means of crime tipping that maintains anonymity of a witness. While crimes are meant to be reported by victims, we often do not prioritize the witnesses in the case unless we know who is coming forward. Considering not every person's statement can be deemed as truthful or legitimate, if we figure out an algorithm distinguish genuine tip-offs, it would help police investigation greatly, as insider information holds a lot of value. We believe everyone deserves to be heard and true justice lies in giving each witness a chance to convey their story without having to fear any external threats. Combining all the available technology, it is very much possible to build an anonymous crime tip off system that enables users to do so. With this research we are hoping to cover all the aspects

that require consideration in crime tipping and be able to serve the society with our innovation.

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