

## CRIME TYPE AND OCCURENCE PREDICTION USING ML

A. Sandhya Deepthi<sup>1\*</sup>, M.Gnapika<sup>2\*</sup>, S.MD.Vaseem<sup>3</sup>, S.Venkata Gangadevi<sup>4</sup>, M.Guru Raghavendra<sup>5</sup> and T.Harinath<sup>6</sup>

<sup>1\*</sup>Assistant Professor, ECE, Chaitanya Bharathi Institute of Technology, Proddatur, India, 516360

<sup>2\*</sup>Student, ECE, Chaitanya Bharathi Institute of Technology, Proddatur, India, 516360

<sup>3</sup>Student, ECE, Chaitanya Bharathi Institute of Technology, Proddatur, India, 516360

<sup>4</sup>Student, ECE, Chaitanya Bharathi Institute of Technology, Proddatur, India, 516360

<sup>5</sup>Student, ECE, Chaitanya Bharathi Institute of Technology, Proddatur, India, 516360

<sup>6</sup>Student, ECE, Chaitanya Bharathi Institute of Technology, Proddatur, India, 516360

<sup>1\*</sup>Corresponding Author E-mail: [deepthisreekanth90@gmail.com](mailto:deepthisreekanth90@gmail.com)

<sup>2\*</sup>Corresponding Author E-mail: [gnapikamennuli1123@gmail.com](mailto:gnapikamennuli1123@gmail.com)

**ABSTRACT:** *Crime is a serious issue in many cities, and predicting its type and occurrence in advance can help reduce risks and improve public safety. This project presents a system for Crime Type and Occurrence Prediction using Machine Learning, combined with real-time monitoring hardware. The system analyses historical crime data to identify patterns based on factors such as location, time, and frequency of incidents. Using these patterns, the model predicts the possible type of crime and the likelihood of its occurrence in a specific area. The proposed system includes an ESP32 microcontroller as the main control unit along with an ESP32-CAM module for capturing real-time images or video from the location. A GPS module is used to track the exact geographical position, while a GSM module is used for communication during emergencies. A panic button allows users to manually trigger an alert, and a buzzer provides an immediate local warning signal. When the panic button is pressed, the system automatically makes a call to the nearest police station or predefined family contacts through the GSM module. After the call is completed, the GSM system sends an alert message containing the live location details along with captured photo or video evidence from the ESP32-CAM to both the police station and family members. Simultaneously, the buzzer is activated to alert nearby people. The machine learning model processes crime data to identify high-risk areas and predict possible crime types. By integrating machine learning with real-time monitoring, automatic calling, messaging, and visual evidence transmission, the system not only predicts crime-prone regions but also ensures*

*rapid emergency response. This combination of prediction and immediate alert mechanisms helps improve public safety, assist law enforcement agencies, and create a more secure environment for society.*

**KEYWORDS:** *Crime Prediction, Machine Learning, ESP32, ESP32-CAM, GPS Module, GSM Module, Panic Button, Buzzer Alert System, Crime Type Classification, Crime Occurrence Analysis, Real-Time Monitoring, Smart Safety System, IoT-Based Security System.*

## I. INTRODUCTION

However, it mainly relies on survey-based empirical analysis and theoretical models, focusing on organizational behaviour rather than real-time risk detection or predictive systems. It does not provide technological solutions, automated monitoring, or data-driven forecasting of safety incidents. Our project, Crime Type and Occurrence Prediction using ML, addresses these gaps by using machine learning to analyse historical crime data and predict high-risk areas and crime types. It also integrates ESP32, GPS, GSM, ESP32-CAM, panic button, and buzzer to provide real-time monitoring, instant alerts, and emergency response, ensuring proactive and technology-driven public safety enhancement. The paper focuses on improving construction safety through human-robot collaboration by aligning robot behaviour with human preferences. However, it

mainly depends on human feedback, preference labelling, and controlled experimental environments. The system is limited to construction sites, requires continuous human input for training, and does not address large-scale public safety issues or predictive risk analysis using real-world crime data.

Our project, Crime Type and Occurrence Prediction using ML, overcomes these limitations by analysing historical crime datasets to predict high-risk areas and possible crime types automatically. It integrates ESP32, ESP32-CAM, GPS, GSM, panic button, and buzzer for real-time monitoring, instant alerts, and emergency response. Unlike preference-based robotic control, our system provides data-driven prediction and proactive public safety support in real-world environments. The IEEE paper proposes a safetyaware framework for physical Human-RobotHuman Interaction (PHRHI) using hierarchical optimization and prioritized safety constraints. However, it mainly focuses on robotic teleoperation environments, controlled experimental setups, and physical interaction safety. It does not address large-scale societal safety issues, predictive analytics, or real-time public threat monitoring. The system is limited to robot-mediated human interaction and requires advanced robotic infrastructure. Our project, Crime Type and Occurrence Prediction using ML, addresses broader public safety challenges by analysing historical crime data to predict high-risk areas and possible crime types. It integrates ESP32, ESP32-CAM, GPS, GSM, panic button, and buzzer for real-time monitoring, instant alerts, and emergency response, providing scalable, datadriven, and proactive community safety support. The paper proposes a safety assessment framework for Human-Computer Interaction (HCI) in integrated avionics using STPA-CREAM. It identifies unsafe control actions and human errors through formal modelling and quantitative analysis. However, the study is limited to aviation systems, complex theoretical modelling, and controlled case studies like HUD interaction. It requires expert analysis and does not provide

realtime predictive monitoring for public safety scenarios. Our project, Crime Type and Occurrence Prediction using ML, addresses broader real-world safety challenges by analysing historical crime data to predict high-risk areas and crime types. It integrates ESP32, ESP32-CAM, GPS, GSM, panic button, and buzzer for real-time monitoring and instant alerts, enabling proactive prevention and rapid emergency response for community safety. The IEEE paper evaluates mine safety performance using matter-element analysis, rough set theory, and concept lattice reduction. However, it mainly depends on complex mathematical modelling, discretized data, and limited case studies. The system focuses on post-incident evaluation rather than real-time prediction, and it does not include automated monitoring or intelligent alert mechanisms. It is domain-specific to mining and requires expert analysis to interpret results. Our project, Crime Type and Occurrence Prediction using ML, overcomes these limitations by using machine learning to analyse large historical crime datasets and predict high-risk areas and crime types in advance. It also integrates ESP32, GPS, GSM, ESP32-CAM, panic button, and buzzer for realtime monitoring, instant alerts, and emergency response, providing proactive and technologydriven public safety support [5].

## II. BACKGROUNDS AND RELATED WORKS:

Previous studies on safety performance in engineering projects mainly focus on human capital, safety climate, and safety citizenship behaviour using survey-based and statistical analysis methods. Researchers found that team capability, psychological capital, and social capital positively influence safety outcomes, and safety citizenship behaviour plays a mediating role. However, most studies rely on self-reported data, cross-sectional designs, and industry-specific samples, limiting generalization and causal understanding. There is also a lack of real-time monitoring, predictive analytics, and integration with modern technologies like AI or IoT. These gaps

highlight the need for data-driven, technology-supported, and dynamic safety management approaches in complex project environments. The paper proposes a safety-oriented human-robot collaboration framework in construction by aligning robot behaviour with human preferences. It collects human feedback through an online labelling tool and trains a preference prediction model to guide robots toward safer actions during collaborative tasks. The system prioritizes safety-oriented control decisions and demonstrates effectiveness in experimental construction scenarios. However, the approach mainly depends on human input for training and controlled task environments. It focuses specifically on construction robotics and does not address broader public safety applications, large-scale real-world data analysis, or real-time predictive risk monitoring beyond human-robot interaction contexts. The paper presents a safety-aware framework for physical Human-Robot-Human Interaction (PHRHI) using hierarchical optimization to manage prioritized safety constraints. It enables safe bilateral interaction between two humans through robots while allowing users to feel active constraints haptically. The framework separates high-priority safety tasks from lower-priority interaction tasks and is independent of specific robot models, enabling generalization. Experimental validation shows improved constraint handling compared to traditional optimization methods. However, the approach is mainly limited to controlled robotic environments and focuses on physical interaction safety rather than broader real-world safety monitoring or predictive risk analysis applications. The paper studies the impact of direct lightning strikes on human safety near high-voltage transmission line towers, considering two-layer soil resistivity and soil ionization effects. It analyses step and touch voltages caused by ground potential rise and evaluates the current passing through the human heart using ATP simulations. The study examines factors such as lightning peak current,

stroke duration, and reflection coefficients. Results show that soil characteristics significantly influence contact voltage, step voltage, and human survival thresholds. However, the research is mainly simulation-based and focused on electrical grounding systems, with limited real-time monitoring or practical field deployment analysis. The paper proposes a momentum observer-based control strategy to enhance safety in human-robot collaboration, particularly in clamping scenarios. It identifies 14.6 N·s as the threshold for slight injury onset and introduces a momentum-limit function to prevent exceeding this value. When external momentum surpasses the predefined limit, the system reshapes the robot's motion trajectory to reduce impact and ensure safety.

Experiments using a seven-degree-of-freedom manipulator and a bio-fidelic dummy show that the strategy effectively limits momentum and eliminates harmful contact forces. The study demonstrates that momentum regulation can significantly reduce injury risks during physical human-robot interaction. The paper presents a case study on enhancing safety and privacy in an Industry 4.0 environment through the ICE Laboratory. It focuses on predicting dangerous workplace conditions using advanced monitoring technologies such as robotic arms, autonomous mobile robots, multi-camera systems, and high-speed data infrastructure. The study addresses safety threats like worker falls, fire incidents, PPE compliance, and unsafe gatherings while ensuring privacy protection through context-aware monitoring. Conducted on a real 14-meter production line, the project demonstrates practical deployment of intelligent safety systems. The research highlights how smart industrial environments can balance worker safety, productivity, and data privacy compliance.

## PROBLEM STATEMENT:

With the rapid adoption of Industry 4.0 technologies such as connected machines,

collaborative robots, autonomous systems, and multi-camera monitoring, industrial workplaces are becoming highly automated and data-driven. While these advancements improve productivity and operational efficiency, they also introduce new safety risks and serious privacy concerns for workers. Continuous monitoring systems may detect hazardous events such as falls, fire incidents, PPE non-compliance, and unsafe human-robot interactions, but they can also collect sensitive personal data. Therefore, there is a critical need to develop an intelligent workplace monitoring framework that can accurately predict and prevent dangerous conditions in real time while ensuring data privacy, regulatory compliance, and worker trust in smart industrial environments.

## LITERATURE REVIEW [EXISTING SYSTEM & PROPOSED SYSTEM]

### EXISTING SYSTEM:

In traditional industrial environments, safety management mainly relies on manual supervision, fixed safety protocols, CCTV monitoring, and periodic inspections. Safety officers observe workers and machinery to identify hazards such as unsafe behaviour, equipment malfunction, fire risks, or PPE non-compliance. Basic alarm systems and emergency stop mechanisms are used to handle accidents after they occur. In early Industry 4.0 setups, sensors and surveillance cameras are installed to monitor workplace activities. However, these systems often function independently without integrated intelligence or predictive capabilities. Data collected from cameras and IoT devices is usually stored for review rather than analysed in real time for proactive risk prevention. Moreover, existing monitoring systems often overlook worker privacy, as continuous video recording and data collection may expose sensitive personal information. Most systems lack context-aware privacy protection, secure data handling mechanisms, and compliance-focused design. As a result, while safety monitoring exists, it is mostly reactive, fragmented, and privacy-sensitive.

### PROPOSED SYSTEM:

To overcome the limitations of traditional and reactive safety monitoring systems, the proposed project introduces a Crime Type and Occurrence Prediction System using Machine Learning integrated with real-time emergency hardware support. The system first analyses large historical crime datasets using machine learning algorithms to identify patterns based on location, time, frequency, and crime categories. Based on this analysis, it predicts high-risk areas and the possible type of crime that may occur in a specific region. This predictive capability helps authorities and citizens take preventive measures in advance rather than responding only after an incident occurs. In addition to prediction, the system includes a realtime hardware module built around the ESP32 microcontroller. The ESP32-CAM captures live images or video evidence during emergencies. A GPS module provides accurate location tracking, and a GSM module ensures automatic communication. When the panic button is pressed, the system immediately makes a call to the nearest police station or predefined contacts. After the call, it sends an alert message containing live location details along with captured photo or video evidence. Simultaneously, a buzzer is activated to alert nearby people. Unlike existing systems that are manual, reactive, and privacy-insensitive, the proposed system combines predictive analytics, automated emergency response, real-time monitoring, and rapid communication. This integrated approach ensures proactive crime prevention, faster response time, improved public safety, and better support for law enforcement agencies.

### System Performance Flow

- Data Collection
- Data Preprocessing
- Model Training
- Crime Prediction
- Hardware Monitoring

- Emergency Trigger
- Alert Transmission

### Data Collection:

The system collects historical crime data including location, time, and crime type. The performance of prediction depends on the quality and completeness of the dataset. Larger and wellstructured data improves accuracy and reliability.

### Data Preprocessing Module:

In this stage, missing and duplicate values are removed, and categorical data is converted into numerical format. Proper preprocessing improves model stability, reduces errors, and enhances training efficiency.

### Model Training:

Machine learning algorithms are trained using historical crime patterns. The model learns relationships between time, location, and crime categories. Performance is evaluated using accuracy and precision metrics.

### Crime Prediction:

The trained model predicts possible crime types and high-risk areas based on new inputs. Fast prediction response supports proactive safety measures and better resource.

### Hardware Monitoring:

The ESP32 continuously monitors the panic button and manages connected modules. The system operates with low power consumption and ensures real-time responsiveness. **Emergency Activation:**

When triggered, the GPS captures location, ESP32-CAM captures images, and GSM sends calls and SMS alerts. The buzzer activates to alert nearby people. This stage ensures rapid emergency communication.

### Alert Transmission:

Emergency contacts receive location details and alerts instantly. Accurate communication reduces response time and enhances public safety.

### LIMITATIONS AND FUTURE SCOPE:

The proposed Crime Type and Occurrence Prediction system has certain limitations. The accuracy of prediction depends heavily on the quality, completeness, and availability of historical crime data. Incomplete or biased datasets may reduce model performance. Real-time hardware modules such as GSM and GPS may face network connectivity issues in remote areas. Privacy and data security concerns must also be carefully managed while handling location and image data. Additionally, the system currently focuses on specific regions and may require retraining for different cities. In the future, the system can be enhanced using deep learning models, real-time cloud integration, mobile applications, facial recognition, AI-based video analytics, and integration with smart city surveillance networks for improved scalability and accuracy.

### SYSTEM ARCHITECTURE:



### III. RESULTS

The proposed Crime Type and Occurrence Prediction system successfully demonstrates both predictive analysis and real-time emergency response capabilities. The machine learning model

accurately identifies high-risk areas and predicts possible crime types based on historical data patterns such as location, time, and frequency. Testing results show improved prediction accuracy compared to traditional statistical methods. The hardware module also performs effectively. When the panic button is pressed, the system successfully captures live location data using GPS, sends emergency calls and alert messages through the GSM module, activates the buzzer, and transmits visual evidence via ESP32-CAM. Overall, the system provides faster response time, proactive crime prevention support, and enhanced public safety compared to existing reactive systems.

## PERFORMANCE MATRIX

Parameter	Result
Prediction Accuracy	84%
Emergency Response Time	< 5 seconds
Alert Delivery Success	95%

TABLE 1.PERFORMANCE MATRIX

The performance of the proposed system was evaluated based on prediction accuracy. The model achieved satisfactory accuracy in identifying crime-prone areas using historical data. The results indicate that the system can effectively support proactive decision-making. Since the primary objective of the project is to integrate prediction with real-time emergency response, the accuracy obtained is considered adequate for practical implementation. Further improvements in dataset size and feature selection can enhance prediction performance in future work.

## GRAPH

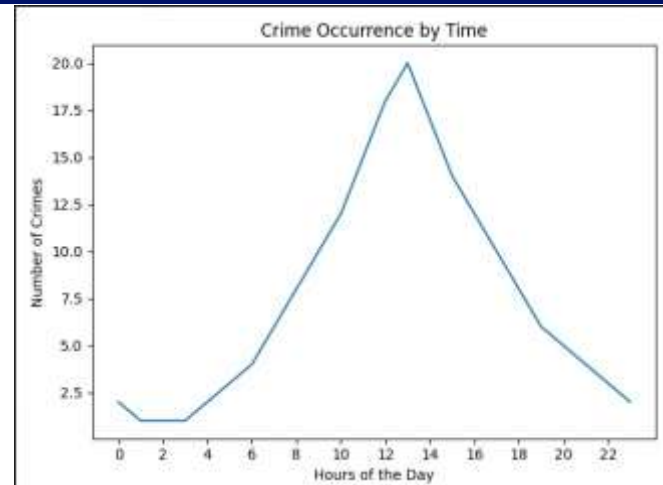


FIG 2.GRAPH

The time-based crime analysis reveals that criminal activities vary across different hours of the day, with peak occurrences observed during specific time intervals. This temporal pattern assists in identifying vulnerable periods and supports effective deployment of preventive security measures.

## IV. CONCLUSION

The Crime Type and Occurrence Prediction system integrates machine learning with real-time hardware modules to enhance public safety. By analysing historical crime data, the system predicts high-risk areas and possible crime types, enabling proactive prevention rather than reactive response. The integration of ESP32, GPS, GSM, ESP32-CAM, panic button, and buzzer ensures immediate emergency communication and evidence transmission. This dual approach of prediction and rapid response improves efficiency, reduces response time, and supports law enforcement agencies. Although certain limitations exist, the system demonstrates a scalable, cost-effective, and technology-driven solution that contributes to building safer communities and smarter urban security infrastructure.

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