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Implementation of AI based Safety and Security System Integration for Smart City

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ABSTRACT- Our Indian government has set a goal of creating 100 smart cities that will use smart technology such as smart grids, smart phones, and various monitoring devices to generate large amount of data. Traditionally, data centres have been in charge of these files. One of the most pressing issues in data centres is resource management. One efficient strategy to address this issue is to use the best method for handling data, and when we're talking about Smart Cities, which will create a big quantity of data, it's becoming increasingly important to manage this massive amount of data.

It is also necessary to provide the better living standard for every citizen in the smart cities by providing good safety and security to them as well. As we know that every citizen is not smart enough to protect himself against the physical as well as cyber-crimes. In this paper, we have designed an advanced Artificial Intelligence (AI) based safety and security system for the human beings and their personal data in a smart city. The system architecture is designed with AI module with machine learning algorithms, IoT technology and sensors, smart drones, intelligent video surveillances, data analytics and cyber security modules. This system can efficiently protect the citizens and their personal data against the criminals with high speed and accuracy.

General Terms: Artificial Intelligence, Internet of Things, Data Science, Smart City Security, et. al.
Keywords: AI, Data Analytics, Smart City, Internet of Things, Safety and Security.

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1. INTRODUCTION

With a population of 1.21 billion people, India is the world's second most populous country. By the year 2050, the population will have risen to 1.6 billion people. India has also seen a significant increase in the average size of metropolitan areas. This has been made possible by a synchronized upward movement in urban technical boundaries, with the objective of increasing the capacity of a city to accommodate more people. The urban population accounts for about 31% of the total population. With urbanization accounting for 60% of India's GDP, it is anticipated that by 2030, India's urban sector would account for roughly 75% of the country's GDP. There was a lot of progress in the field of information technology. While developing cities, India, on the other hand, fails to leverage the importance of IT in effective governance.

There has been very little work put into developing a strategy for attaining "Smart" urban growth for its metropolitan and municipal cities. Numerous meanings of "smart city" exist, and "smart" approaches have been seen diversely by various individuals and segments. A couple of definitions observe that smart urban areas are those urban areas with smart (intelligent) physical, social, institutional and economic infrastructure while ensuring centrality of citizens in a sustainable environment; refer to key attributes characterized by particular elements (for example smart mobility, smart environment, smart living, smart governance); and focus on the imperative usage of new innovation and imaginative ways to deal with improve the efficiencies and intensity of urban regions. Smart Cities are the reconciliation of data innovation, media communications, urban arranging, smart foundation and activities in a domain equipped to augment the personal satisfaction for a city's populace. Urban communities are based on the three mainstays of Infrastructure, Operations and People. In a Smart City, not exclusively is every single one of these columns imbued with insight, yet more critically the columns work in an interconnected and coordinated manner to use assets effectively.

The development of IoT is driven by the changing idea of equipment, that smartness and availability takes into consideration physical items to be a piece of the web. IoT infers that items, or "things", are getting smart and associated. These two qualities have recently existed independently, for example physical items which have been either smart or associated, yet are presently progressively being embraced in physical things all the while.

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A smart city is one in which conventional networks and services are made more flexible, efficient, and sustainable via the use of information, digital, and communications technology to serve the city's occupants. Smart urban communities are cleaner, safer, faster, and friendlier. A smart city's numerous components include smart infrastructure, smart transit, smart vitality, smart social insurance, and smart innovation. The Internet of Things (IoT) and big data, two closely connected emerging innovation systems, make smart urban environments productive and responsive.

1.1 AI for Smart Cities

Artificial Intelligence [1] is a term that refers to a man-made device that can learn, understand, and apply information. It is defined as the science and engineering of producing intelligent machines by John McCarthy, the founder of AI.

AI Applications

- Predication and forecasting
- Early warning system
- Resilience infrastructure
- Resilience planning

A smart city has different use cases for AI-driven and IoT-empowered innovation, from keeping up a more beneficial condition to propelling public transport and wellbeing. By utilizing AI and machine learning calculations, alongside IoT, a city can get ready for better smart traffic arrangements ensuring that occupants get starting with one point then onto the next as securely and proficiently as could be expected under the circumstances. Machine Learning gathers information from various focuses and passes on everything to a focal server for additional usage and once information is gathered, it must be used in making a city smarter.

Machine learning by and large takes the information produced by a few applications, for example, Health MD applications, web empowered vehicles, and so on and use it to recognize designs and figure out how to improve the given arrangement of administrations. Its apparatuses can customize the smart city experience by collecting data about the most utilized streets in a city and afterward apply it to a transportation framework.

Then again, machine learning and AI can be useful in squander assortment and its legitimate administration and removal which is a fundamental metropolitan action in a city. Consequently, the innovation for smart reusing and waste administration gives a maintainable waste administration framework. Computer based intelligence can see how urban areas are being utilized and how they are working. It helps city organizers in fathoming how the city is reacting to different changes and activities.

Along these lines, AI-controlled PC vision frameworks, for example, could empower PCs to spot a huge number of components of urban life in a tune, including individuals, public specialists, vehicles, mishaps, fires, debacles, rubbish and substantially more. The framework permits for self-sufficient checking as well as to settle on choices dependent on the exhibition of every one of these components, changing practices through the span of every day or time, and reactions to city frameworks by every component.

The advances that AI and machine learning are bringing to the way cities function, communicate, and maintain public civility come with a few drawbacks. As a result, modified arrangements must be considered in order to keep smart city operations moving forward. As a result, current smart city programmed based on AI and ML look to be advancing city administrations and lifestyles in areas such as transportation, lighting, health, network, and administrations, among others.

We can only reduce the number of people killed and the amount of money lost by implementing a scientifically sound strategy aided by computers, information communication technology (ICT), and artificial intelligence. Because Artificial Intelligence is the present and future age of engineering, it is not enough to employ ICT just for human safety and security. As a result, artificial intelligence must be used to reduce human life losses and rescue operation time by utilising robotics, drones, sensors, and other technologies.

2. LITERATURE REVIEW

The authors Dattana, V., Gupta, and Kush A. [10] have developed aprobabilistic model for the security in smart city. It includes exceptionally delicate and various data like individual, organizational, environment, energy, transport and financial data. Data Analytics can give answer for different issues being looked by smart cities like emergency action system, disaster resilience, smart traffic framework and so forth; it requires distribution of sensitive data among different elements inside or outside the smart city. The proposed model detects the data leakages that are due to wither intentional or unintentional using the guilt model and data analytics.

In the paper [11], the authors N. Kazak and N. Shamayeva have studied the separate aspects of smart cities security. While making cities, there is consistently the protection of the basic infrastructure and the methods for controlling it. So also, it is important to guarantee the security of the computerized infrastructure. The essential standards of developing advanced insurance for a smart city include: device discovery and access control, data integrity and threat prevention.

N. M. Kumar, S. Goel, and P. K. Mallick[12] address "smart cities in India: Features, policies, present state, and difficulties." Smart cities are essential for a great living. In their view, it's a mix of technology for smart and sustainable activities. Authors examined smart city definitions based on general methodology and the 3-C principle (Competence, Convenience, Cleverness). Based on mass observation systems from the USA and UK, [13] a full analysis of smart city security systems was offered. They highlighted design challenges for smart cities.

In the paper [14], the authors A. Giyenko and Y. I. Cho have implemented the a smart city Unmanned Aerial Vehicle (UAV) that to focus about the "Device as a service" model to execute a keen service dependent on the M2M model, Multi-agent Systems and Smart City standards. They have examined the potential uses of UAV in a Smart City condition, potential issues and solutions. They have examined the system incorporation of the UAV's and look at the correspondence advances to be utilized. In the paper [15], the authors N. Dlodlo, O. Gcaba and A. Smith have found a practical resolution for energy control and comfort in the room for substantiation of idea of the smart city infrastructural applications. They discussed on how smart applications be able to deal with energy control and comfort in the room by

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varying number of people and the appliances, with each being a source of heat.

3. SYSTEM ARCHITECTURE

There are the few system architectures have been implemented using the 'rule-based' AI algorithms. They are mainly dependent on the rule-set which are used to detect the abnormal activity or persons. This rule-set was fed into the system by the programmer. These systems are pre-coded by the programmer. Few more system architectures have been designed using the behavior analytics. The main advantage of these systems is its self-learning capability which may not require any initial programming. The AI completely depends on its own observations about the targeted objects. Accordingly, it prepares its own database about the different objects and observations obtained from them. IoT has been playing a major role in the design of efficient Artificial Intelligence systems [17]. AI finds major application in the design, implementation, monitoring and management of smart cities. The video surveillance system with an integration of intelligence provides an advanced security over the conventional video surveillance systems. The proposed system architecture is shown in *figure 1*.

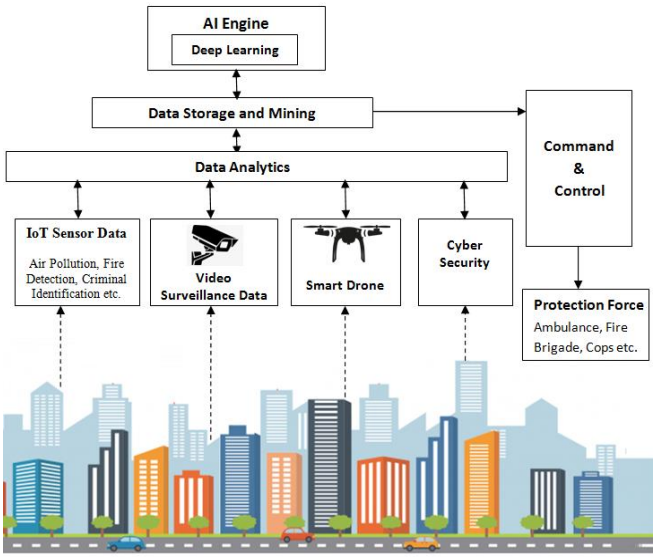

Figure 1:AI based safe and secure smart city architecture

3.1 IoT applications for AI based smart city safety & security

The following are the major aspects that are to be considered for the smart city safety and security issue that can be resolved to some extent with the help of IoT technology and the sensors adopted in it as shown in *table 1*.

3.1.1 Criminals identification

Police can identify the criminals very easily using the mobile biometric detection machines with IoT. Using these devices, the cops can send the captured fingerprint data to the server of "criminal identification databases" and compared to get the criminal detection faster.

3.1.2 Disaster Management

Satellites identify heat marks of a fire that has quite recently begun in a territory. The satellites transfer the data to a control centre that can register the fire in their frameworks and dispatches fire engines. A similar control centre triggers fire alarms that are set at key focuses in the zone to caution the residents.

3.1.3 Environmental Management

The city engineers install sensors over the city that measures temperature, humidity, CO2, CO, NO2, noise and particles. In the event that any of the parameters go over a set limit, the GPS-empowered sensors send a caution to a central hub. The hub thus sends the data to the residents.

3.1.4 Motion Sensors& Security

IoT sensors contribute particularly more in the domain of motion detection and security with sensors for vibrations, collisions, beacon and entryway sensing.

3.1.5 Health Care

Mobile applications, body area network sensors and individual health the management ecosystems systems have been perceived as fundamental parts of the innovative foundation of the next generation of healthcare for their capability to permit residents to assume a functioning job in the administration of their health. Mobile health applications (advanced mobile phone and tablet) can interface with clinical gadgets or sensors (for example wristbands, smart watches, etc.) and give individual help and updates. Using sensors straightforwardly associated with mobile gadgets, it is presently conceivable to accumulate a lot of information.

Table 1: IoT Applications for AI based smart city safety & security

IoT Sensors	Application
Air Pollution	To monitor the carbon dioxide and carbon monoxide emission in the air
Fire Detection	To monitor the combustion gases, fire condition
Water Quality	To monitor the water quality and checking for drinkable or not
Perimeter Access Control	To monitor the restricted areas
Electromagnetic (EM) Level	To measure the EM radiation level by Cell towers, Wi-Fi routers, etc.
Radiation Level	To measure the radiation level in nuclear plant surroundings to alert on any leakages

3.2 Intelligent CCTV Surveillances

These intelligent surveillance systems calculate the potential risks by analyzing the recorded human activity. AI is most efficient in such tasks by performing video analytics which can differentiate the normal and abnormal activities of human beings. For this purpose, these systems use "behavioral analytical software's such as AIsight" [1].These systems initially learned with the normal human behavior so that they can differentiate the suspicious activities. Employing such systems can effectively reduce the crimes in the city.

3.3 Application of Smart Drones for Command and Control

Drone is the unmanned aerial survey vehicle. They can carry out wide aerial of surveillance within the less time without any

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manpower requirement. By performing analytics operations on the recorded surveillance video with AI system called as smart drones can efficiently monitor and control the city. By connecting the necessary peripherals (like audio device, etc.) with the drones, we can make the announcements in case of detection of any suspicious activity. These drones can easily fly into the hazardous places like collapsed buildings in case of emergency to save the people. There are several applications that the smart drones can be employed like traffic monitoring, crowd control, fire control and civil surveillances. On the overall with the help of smart drones we can control the crime rate to a great extent so that providing safety and security to the civilians in the city.

3.4 Artificial Intelligence & Cyber Security

The AI system consists of large amount of data which was collected from the IoT sensors, video surveillance systems and drone cameras. Processing and maintaining privacy of this data is also an essential task. As the cyber-crime is increasing every day, the Artificial Intelligence plays major role in maintaining the privacy and processing the huge amount of data at a high speed with great efficiency. The most efficient machine learning algorithms are used in these AI systems. The system is trained in the learning phase to detect the files with vulnerability. These systems are integrated with natural language processing, neural networks and data sciences with antivirus to detect the cyber threats. Few AI systems are designed with the predictive cyber security that can overcome the loopholes of conventional cyber security methods in a predictive manner. Examples of such systems are the Spark Cognition, Dark Trace, JASK, etc.

4. IMPLEMENTATION & RESULTS

Smart cities have the open data portal to provide the criminal's data in online. Here we have considered the dataset that provides crime data record in India [16]. And we have trained a model that predicts the type of crime and its details. It has 39 discrete crime categories and it's a multiclass classification problem. The following machine learning algorithm helps the AI system in detecting the crime details and classifying the crime in a Smart City. The algorithm and corresponding code is shown below.

4.1. Algorithm

Step 1: Load the dataset available in the csv file
Step 2: Obtain the category and description fields for training and testing dataset
Step 3: Perform the text processing operation of the above data for categorization, description and to obtain the features.
Step 4: Now, the data is ready, we split it into training and test dataset.
Step 5: Let's fit a simple logistic regression model for it.

Program for step 1:

```
data • spark.read.foroat•csv"). \
      options(header•¯true inferschelea."true"). \
      load(•sf_crioe_dataset.cse)
datapcolu•ns
```

Program for step2:

```
drop_data • ['Dates'• P0a)OfWeekg, 14)istrict'•
'Resolution', 'Address', data • data.selettacolton for
colon in data.coltons if column not in drop
data.shot(5)
```

Program for step3:

```
• Split the data randomly into training and test data
sets.
(trainingData, testoata) dataset.ramkomSplit((0.7, OM,
seed • Imp) print("Training Dataset Size: ' •
str(trainingData.count()))
Printrtest Dataset Size: " • str(testData.count()))
```

Program for step 4:

```
regular expression tokenize.,
e_Tokenizer - RT(Input(ol--Desc.ipt-,
Coutpartfol--pords", pattern--\\M')
stop cords
stop_pords_reeover - Sedt(inputCol --words'. outputCol
-"filtered -).setStopelo.deietOP_PO,de/
nag of ...ores count
count_vettorsCoontVectoPiver(lopotCol.-filtored-,
outpotCol --feature. vocebSixe -10000, mini:K-5)
```

Program for step 5:

```
+--------------+--------------------+
|      Category|            Descript|
+--------------+--------------------+
|      WARRANTS|      WARRANT ARREST|
|OTHER OFFENSES|TRAFFIC VIOLATION...|
|OTHER OFFENSES|TRAFFIC VIOLATION...|
| LARCENY/THEFT|GRAND THEFT FROM ...|
| LARCENY/THEFT|GRAND THEFT FROM ...|
+--------------+--------------------+
only showing top 5 rows
```

Figure 2: Category of crime and description

Figure 3 shows the results obtained after performing the *step 3*, in which the feature vectors are obtained and labeled accordingly.

```
+--------------+--------------------+--------------------+--------------------+--------------------+-----+
|      Category|            Descript|               words|            filtered|            features|label|
+--------------+--------------------+--------------------+--------------------+--------------------+-----+
|      WARRANTS|      WARRANT ARREST|   [warrant, arrest]|   [warrant, arrest]|(809,[17,32],[1.0...|  7.0|
|OTHER OFFENSES|TRAFFIC VIOLATION...|[traffic, violati...|[traffic, violati...|(809,[11,17,35],[...|  1.0|
|OTHER OFFENSES|TRAFFIC VIOLATION...|[traffic, violati...|[traffic, violati...|(809,[11,17,35],[...|  1.0|
| LARCENY/THEFT|GRAND THEFT FROM ...|[grand, theft, fr...|[grand, theft, fr...|(809,[0,2,3,4,6],...|  0.0|
| LARCENY/THEFT|GRAND THEFT FROM ...|[grand, theft, fr...|[grand, theft, fr...|(809,[0,2,3,4,6],...|  0.0|
+--------------+--------------------+--------------------+--------------------+--------------------+-----+
only showing top 5 rows
```

Figure 3: Feature vectors obtained after text processing

In this way, the machine learning model helps the AI to categorize the data from the criminal database. On the test dataset, it provides 97% accuracy.

Following are the few example modules that have been designed in this project implementation. An intelligent CCTV camera in an action to detect the abnormal activity by performing video analytics on the recorded video is shown in *figure 4*.

Figure 4: An intelligent CCTV camera performing abnormal activity detection

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Figure 5 shows the smart drone capable of performing video recording, analysis and announcements with the help of speakers attached to it.

Figure 5: Smart Drone

Figure 6 shows the air pollution detection device, it uses the different sensors to measure the carbon dioxide, carbon monoxide emission levels and other pollution agents and particle in the air.

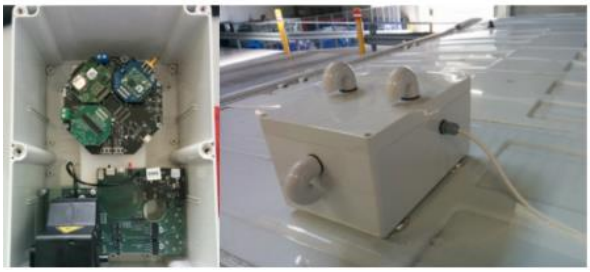

Figure 6: Air Pollution measurement device

5. CONCLUSION

In this paper, we have designed and implemented the Artificial Intelligence based safety and security system for smart city. Here, this project is aimed towards the provision of safety and security for the civilians and their personal data. As we know that every citizen may not be intelligent enough to identify the crime against him. These AI based safety and security systems alerts the people about the security and privacy threats, potential dangers, hazardous risks, thieves, criminals, fraudulent activities and cyber-crimes. Also, these systems can protect the people from such kind of issues. In this paper, we have also discussed about the different examples of AI based security systems. We have proposed, an AI based architecture with an integration of IoT sensors, Intelligent CCTV surveillance, smart drones and cyber security modules for the protection of people in a smart city. The machine learning algorithms are used for training and testing purpose of the system. With the advent of machine learning algorithms, this system can deliver the maximum efficiency with high speed and accuracy. Future research includes multi cloud federation and edge computing.

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