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Smart Cities towards Artificial Intelligence

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Abstract

The creation of smart cities has come a long way in recent years, especially in domains that use AI, such IoT-based components, security systems, smart living options, and environmental monitoring. These advancements seek to build surroundings that meet human requirements by utilizing cutting edge technologies such as automated parking, smart healthcare, and seismic monitoring systems. Even with these encouraging advancements, the current generation of smart cities is still unable to attain genuine autonomy, particularly when it comes to component-level autonomous situation management and decision-making. The transformational perspective proposed in this work views the constituent components of smart environments as self-governing agents with the ability to make decisions. The purpose of these autonomous agents is to improve security and smart living by being able to self-manage and react automatically to different situations. Such autonomous agents can be integrated to accomplish the goal of artificially intelligent smart cities. In smart cities, autonomous agents may behave pro-actively without human involvement by continually monitoring and analyzing data, anticipating possible problems, and taking proactive actions. In the context of smart healthcare, these agents may, for example, track a patient's vitals in real time, anticipate possible health emergencies, notify medical personnel, or even start emergency procedures. Autonomous agents may dynamically assign parking spots in the context of smart car parking based on real-time data, maximizing space use and minimizing traffic congestion. Agents that can autonomously manage emergency actions, such as directing people to safety and managing infrastructure to minimize damage, might be beneficial for earthquake detecting systems. As autonomous entities endowed with decision-making skills are included, we are moving closer to truly intelligent cities. Because of these agents' capacity for independent operation and quick response to changing circumstances, smart cities are able to offer a better quality of security and service while accommodating the changing demands of its residents. As a result, smart cities that have these intelligent agents installed will be more responsive, efficient, and resilient—ultimately capturing the spirit of artificial intelligence in urban planning.

Keywords: smart cities; smart environment; decision making; autonomous agents; artificially intelligent smart cities.

INTRODUCTION

Understanding of artificial intelligence (AI) and the possible administration of intelligent systems has drastically changed with the emergence of machine consciousness(Rafiq et al., 2024). During last decade many development has been done in the field of smart city like internet of things (IoTs), that can applied in multiple scheme such as environment

monitoring, smart parking, smart health, navigation system for urban bus rider and autonomous driving*(Talari et al., 2017)*. Smart cities defined as small country which is surrounded high level information and *technology(Dameri, 2013)*. Smart cities can be defined inthree ways; smart technology, people and collaboration. The most cardinal part of smart city development is a technology due to ICT (information and communication *technology)(Albino, Berardi, & Dangelico, 2015)*. Vienna University of technology explains six components of smart city which are smart economy, people, mobility, environment, governance and living(Anthopoulos & Fitsilis, 2014). The smart living is associated for enhancing security and public safety by artificial agents; those are serving at different places like in academia, shopping mall, traffic signal and airport platform. In this artificial intelligence agents have build up byusing wireless devices and network like camerasas an agent. This network is group of many intelligent agents in MAS (Multi- Agent System).

MAS is component of distributed artificial intelligence, every agents share knowledge and communicate with each other(Balaji & Srinivasan, 2010; Eigenraam & Rothkrantz, 2016). MAS covenant with each agent those are accessible to attain common goal for problem solution (Paull et al., 2012). From last decade every agent detects movement of human for security of living in smart environment(Friess & Herwig, 2017). Other than that incapable to react in real time environment according to situation and don't take decision. Consequently at different occasion high level of security and protection is necessary such as crimes, terrorism and emergencies so as to control at real time (McCarthy, 1995).The cities are not smart as they cannot perform smartly in finding the solution of the problem as criminal detection, terrorism. Then the question arises, how cities can be smart and what components are needed to make it smart and make them autonomously work on the basis of collaborative effort? However conscious agents are necessary for enhancement of security in smart cities, that have high (phenomenal) and low (access) level components.

These conscious agents have decision making capability according to environment and take action(Gamble, 1997; Roscia, Longo, & Lazaroiu, 2013). This paper proposed the solution of problem of cities, having agents comprises of components, agencies of conscious agents and also having phenomenal and cognitive capability.So that such agents have better decision-makingcognitive capability and take action at real time before happening any negative activity, so that these cities will be considered as artificial intelligence-based smart cites.

LITERATURE REVIEW

At smart city IDASC (intelligent distributedautonomous smart city) facilitate with different components ICT that provide different protocol and standard which are essential for security. This IDASC integrated with multi-agent system. A model of multi-agent system has discussed that make intelligent city and control the real time urban crime, emergencies and terrorism for urban safety. Recently proposed surveillance system perform real time human object tracking for smart surveillance like abnormal behavior detection. It proposed three layer automatic surveillance system architecture(Xu et al., 2018).

Figure 1.
Automatic Surveillance System Architecture

According to above Figure.1, edge computing is using for detecting and tracking human targets. A HOG and SVM based human object detection and tracking algorithms are apply on the edge and fog nodes. This algorithm works better when detect a human from an angle zero if angle of camera changes, then hard to detect human object. In this paper represent frame work for criminal detection by using automated CCTV video capture system. According to given bellow figure.2 for face detection a viola jones algorithm and blob analysis used which have three phases, extraction, refinement and analysis. After that sparse finger print classifier used for detect faces of human. But this system recaptured the image that has noise.

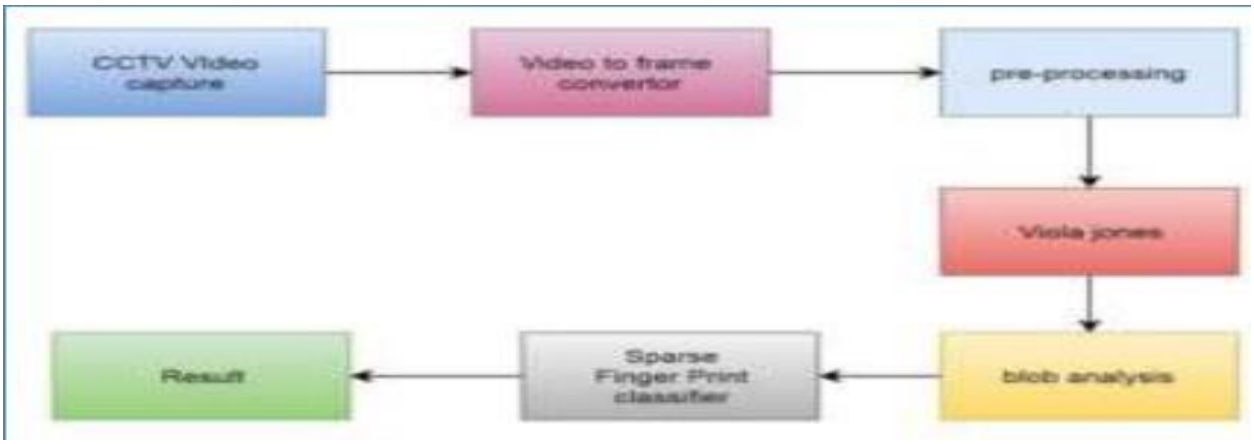

Figure 2.
System Architecture

An automated video surveillance system designed that is based on three stage of working

- Detection of moving object at camera by detection algorithm.

- Automatically make a route model of moving object by applying movement parameters.
- At last semantic reasoning and ontologyused to identify alarm at conceptual level and nature of event(Calavia, Baladrón, Aguiar, Carro, & Sánchez-Esguevillas, 2012).

Thus this intelligent video surveillance system able to detect abnormal object and explain the image what is happening, and alert by alarming situation for smart city safety. The accuracy of this architecture depends directly on route direction. This proposed a surveillance system by using multi cameras as agents. These agents are distributed at smart city for detection and tracking and analyzing ofsuspicious objects. Everyday many accidents happened as result of behaviors of car driver. Therefore this system is used to detect behavioror car driver on the base of hierarchal reasoning,and also designation of escape car driver can track(Eigenraam & Rothkrantz, 2016).

In this an intelligent decision computing framework designed for crowed monitoring at smart city, for detection and tracking of moving people from dense crowds extracted by individual and holistic features of crowd motion(Kumar, Datta, Singh, & Sangaiah, 2018). Designed an Active disaster response system (ADRS) automatically perform actionswhen earthquake happened. An alert message send in XML based standard like common alert protocol (CAP) by official agencies and automatically perform actions like opened doors, windows and cutting off power lines and gas valves before happening earthquake. Activeresponse disaster operation takes 15s so peoplehave enough time to move safe places. But when system fails to response its functionalityis reduced(Lin, Chu, Ku, & Liu, 2014). These all-proposed systems are working atsmart cities but all of these are not autonomous(conscious) due to lack of some components. This purposed system to make smart city.

Comparative Analysis

This section defines the critical analysis of different models of the papers. The working of each paper framework depends on the environment. We conscious with availability of both high- and low-level components that have ability of decision and react according to environment in real time. Define the each framework by comparative analysis on the bases of different parameters shown within the Table I, including main focus, models, cognitive capability, security in smart city and high level and low level access. Each model has some faults and limitations, according to these papers. Is used for real time uninterrupted moving human object tracking automatically for surveillance such as safety monitoring in smart city. But it doesn't have behavior action and not react against malicious activity before happened. This paper used for security analysis by detection of faces in real time by CCTV.

It captures human faces and matched with database saved record and detect authorized and unauthorized person.It doesn't have cognitive capability. Its framework somehow used for criminal detection and don't take action when criminal founded. Major focus of is at safety and security in smart cities by detecting abnormal objects. It partially covered cognitive capability like decision making on the base route direction. Despite that only able to handle traffic control, crowed control and fire alarms. It doesn't take action real time to control suspicious behavior before happening accident. Used to detect, track and analyze suspicious object by smart cameras in real time that are

modeled as agents. Each agent prepared with knowledge based system and able to reason on the base of observed features hence somehow it has cognitive capability. However, it doesn't take action before happening accident or escaping car driver.

Table 1.
Comparative Analysis

Name	Main Focus	AI model based	Cognitive capabilities	Security in city(criminal) smart	High level(phenomenal) + Low level (access)
Real-Time Human ObjectsTracking forSmart Surveillance at the Edge	Detect and track human targets	Covered	Not covered	Partially covered	**Not covered**
Criminal Detection usingMulti-cameras System	Authorized persons detection	Covered	Not covered	Partially covered	**Not covered**
A Semantic autonomous Video Surveillance system for densecamera networksin smart cities	Detect anomalous object and explain the image what is happening	Covered	Partially covered	Partially covered	**Not covered**
A Smart Surveillance System of Distributed Smart Multi Cameras modeled as Agents	Use of smart cameras for automatic detection of suspicious behavior by hierarchical reasoning.	Covered	Covered (knowledge based)	Used at smart city for security (car accidents)	**Not covered**
Active Disaster Response System for a Smart Building	**Take emergency Tasks before happening disaster**	**Covered**	**Partially Covered**	**Partially covered**	**PartiallyCovered**

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However, it doesn't take action before happening accident or escaping car driver. In this paper of an Active disaster response system (ADRS) is to save peoples before happening earth quake. It is AI based and partially sport cognitive capability only for simple task act upon. It is simple actions are open door, windows and cut off gas valves, electric circuits. But it is not smartly work due to lack of high-level component. *Outlining numerous elements including data sources, use cases, AI models, and advantages is necessary to create an extensive collection of tables that describe the various AI models and their applications in smart cities. This is a methodical approach:*

Table 2.
Data Sources in Smart Cities

Data Source	Description	Examples
IoT Sensors	Collect real-time data on various parameters	Traffic flow sensors, weather stations, air quality monitors
Public Records	Government and public service data	Census data, property records, crime statistics
Social Media	User-generated content and interactions	Tweets, Facebook posts, Instagram photos
Mobile Data	Data from mobile devices	GPS data, app usage, mobile transactions
Infrastructure Data	Data from city infrastructure	Utility usage (water, electricity), waste management data
Environmental Data	Information on environmental conditions	Weather forecasts, pollution levels, green space metrics

Table 3.
AI Use Cases in Smart Cities

Use Case	Description	Examples
Traffic Management	Optimizing traffic flow and reducing congestion	Intelligent traffic lights, real-time traffic monitoring
Public Safety	Enhancing security and emergency response	Predictive policing, real-time surveillance analysis
Energy Management	Optimizing energy usage and promoting sustainability	Smart grids, energy consumption forecasting
Waste Management	Improving efficiency in waste collection and recycling	Route optimization for waste collection trucks
Environmental Monitoring	Tracking and improving environmental health	Air quality monitoring, noise pollution control
Public Health	Enhancing healthcare delivery and disease prevention	Predictive health analytics, epidemic outbreak prediction
Urban Planning	Improving urban infrastructure and resource allocation	Land use optimization, infrastructure maintenance prediction
Transportation	Enhancing public transportation systems	Predictive maintenance for buses/trains, route optimization
Water Management	Ensuring efficient water usage and quality	Leak detection systems, water quality monitoring

Table 4.
AI Models Used in Smart Cities

AI Model	Description	Use Cases
Machine Learning	Algorithms that improve automatically through experience	Traffic prediction, energy usage forecasting
Deep Learning	Neural networks with many layers for complex pattern recognition	Image recognition in surveillance, speech recognition
Natural Language Processing	AI that understands and generates human language	Chatbots for public services, social media analysis
Computer Vision	AI that interprets visual information	Traffic monitoring, waste sorting
Predictive Analytics	Using historical data to predict future events	Crime prediction, healthcare analytics
Reinforcement Learning	AI that learns by interacting with its environment	Autonomous vehicles, dynamic traffic light control

Table 5.
Benefits of AI in Smart Cities

Benefit	Description	Examples
Efficiency Improvement	Enhancing the efficiency of city operations	Reduced energy consumption, optimized traffic flow
Cost Reduction	Lowering operational costs	Automated waste collection, predictive maintenance
Enhanced Safety	Improving public safety and emergency response	Crime reduction, faster emergency services response
Environmental Sustainability	Promoting sustainable practices and reducing environmental impact	Lower emissions, better resource management
Improved Quality of Life	Enhancing the living conditions for residents	Cleaner air, better public services
Data-Driven Decision Making	Enabling informed decisions based on data analysis	Urban planning, policy-making

These tables give a clear grasp of the many components and their advantages, as well as an organized summary of how AI may be implemented into various areas of smart cities(Bano, Hussain, Arif, Khursheed, & Arif, 2024; Hussain, Azam, Bano, Nasir, & Manan, 2023; Hussain et al., 2024).

PROPOSED MODEL

According to its models not smartly work due to lack of autonomously react of its components. This paper proposed work model to make every components of smart cities as autonomous agents. At smart cities the component camera can use as autonomous agents. These autonomous agents have decision making ability, so its working capability will be autonomous and auto reactive. Human's efforts will be reduced by using autonomous agents at smart cities. In this proposed model autonomous agent have four parts, first stage isperceived, second stage is analyze, third stage evaluate and last stage is react. Its system model is given bellow.

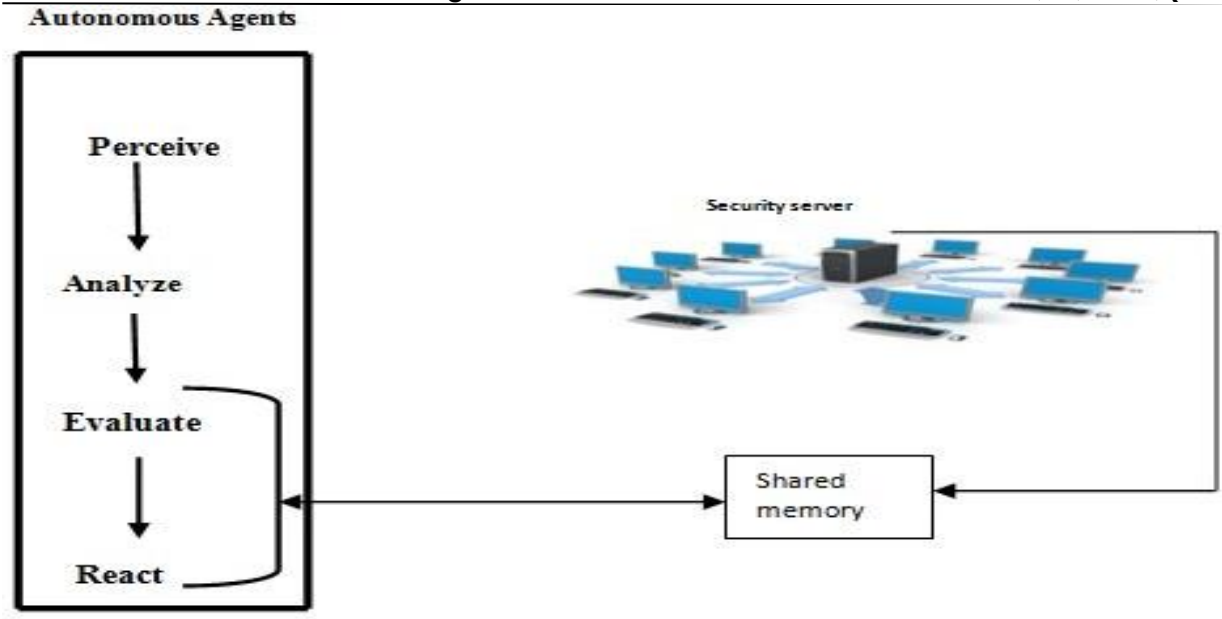


Figure 3.
Proposed Model for AI smart cities

- **Perceive**

This is first stage of model. At this stage agents get input from environment. It identifies the environment and objects that are present in environment. After perceive input it start to understand its work and situations.

- **Analyze**

After perceive stage its second module analyze start that is used to understand problems. It can help agents to increase knowledge and understanding in the environments.

- **Evaluate**

That is third stage of model here after analyze that evaluate module have ability to select previous present rules according to their different problem situations. It evaluate similarity or dissimilarity between two objects, that is simple task for human but difficult for agents so depend on context and produce valuein numerical form.

RESULTS AND DISCUSSION

According to our proposed system that model has four main parts, perceived, analyzer, evaluate and react. In this simulation work multi-cameras are applying as autonomous agents for making city smart and autonomous. First module perceived videos and convert into multiple frames for detection of the all-multiple human faces at real time. These cameras situated at public area like shopping mall, traffic crowd, academia places and airport. It also works as auto react at real time when found any suspicious human. Face detected module is used to detect single aremultiple human face from real time video frames. It can detect frontal faces from videoframes. It is used to detect faces in spite of their scale, orientation, age, position and expression. For better performance and quality of facedetection in this rotation angle, images resizewidth

and threshold parameters are defined. At this stage various objects that are human faces draw rectangle on it otherwise are removed that objects. After detecting the human faces facial captured image. That is last stage of autonomous agents. If an agents select any rule from its previous or past memory than it have ability to react according to their environment. When any similarity find according to defined problem, agents should react according to their environment. It required changing its behavior according to situation and taking action to avoid from any negative activity.

A. Memory based

This saved information comes from previously happened actions that have done in environment. If any related problem solution presents then it starts to work according to their situation at run time. Therefore, it is helpful for further working and behavior of object. At run time if any problem solution not present in previous memory than it has solution on the base of knowledge. Security server sends its previous data into shared memory. features are extracting into four parts eyebrows, eyes, nose and mouth. Feature extraction technique is very important for face recognition that is useful for distinguishing between faces of different persons. Classification is based on face identification that is used to verify each detected face by comparisons of all templates stored data with shared database. Any detected face matched with it and then alert security agencies about criminal. . For that a comparison equation is used to compare the features of saved and real time image.

$$d(A,B) = \sqrt{\sum_{i=1}^{n}(Ai - Bi)2}$$

Object A is features of saved image and object B

is features of real time image.

In this simulation work main parts are used.

- Agencies (Criminal detail)
- Agents Reaction (criminal found) Security agencies save and give the information of criminal to the agent such as ID, Name and

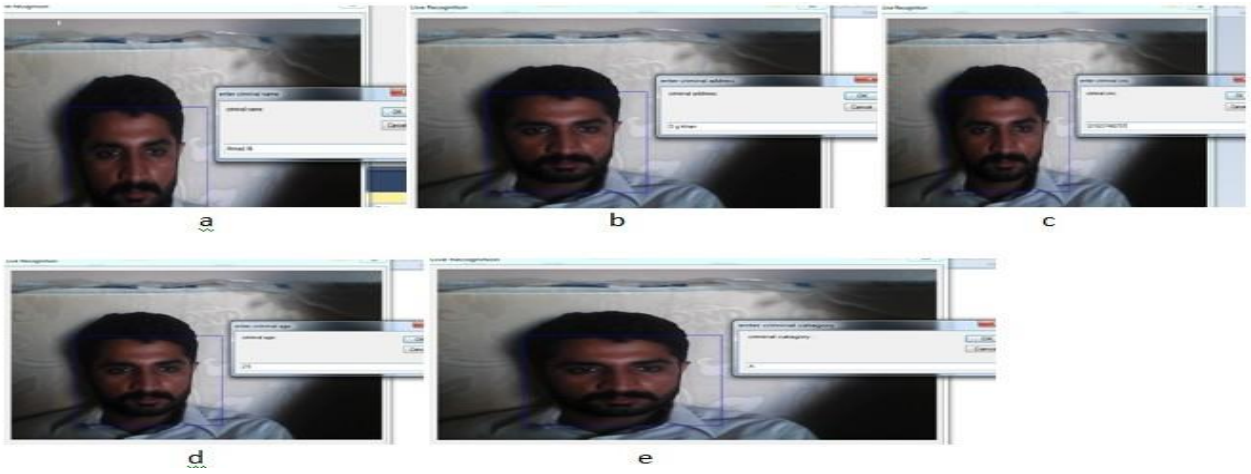


Figure 5.
Simulation

Here security agencies save information of that criminal in to server by an assigning an ID as tracker. In simulation part 'a' captured image with its given name like here criminal

name Ahmad Ali has been entered. In part 'b' of that figure an address of the criminal entered. In 'c' ID card number, and'd' age of that criminal saved. At last in 'e' part category of that criminal entered. After perceive input it can understand the problem of environment. At perception stageit can understand work and its situations. According to this perceive information it can understand and identify the object, and its problem statement according to their environment.

Its results information according to given bellowfigure6 is:

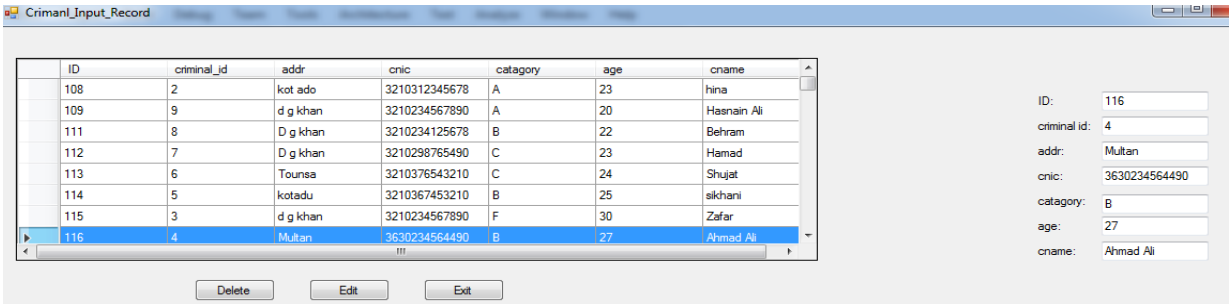


Figure 6.
Information

The working of autonomous agents is to perceive the information that is given by agencies and finds that object in the environment according to their situation.

It can detect object at any condition at any placeand can take action.

Figure 7 and Figure 8 depicts that human faces can be similar and dissimilar with its shared memory knowledge then agents do not reactautonomously. When agents its information matched its previous information (experience) than it will react autonomously. It will show the tracker ID and with in real time. These intelligentagents detect and show own name and the criminal name from shared memory.

Figure 7.
Similar

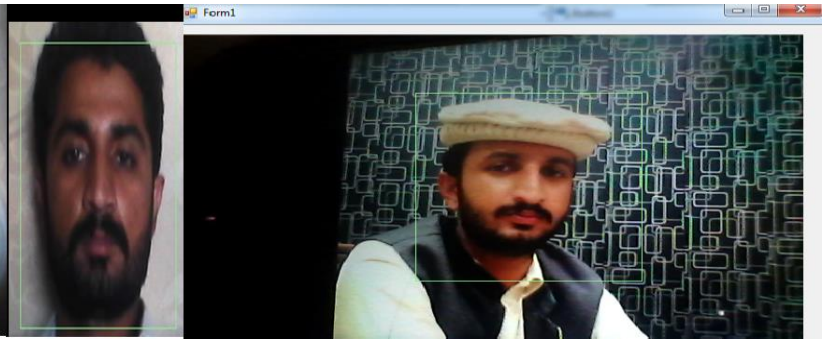


Figure 8.
Not similar

Figure 7 and Figure 8 depicts that human faces can be similar and dissimilar with its shared memory knowledge then agents do not reactautonomously. When agents its information matched its previous information (experience) than it will react autonomously. It will show the tracker ID and within real time. These intelligentagents detect and show own name and the criminal name from shared memory. from shared memory. Different intelligent agents are situated at different places. These agents send information of criminal where

founded. For inserting and updating of criminal record in the shared memory peoples are not necessary, that work is also to do byautonomous agents. Such as shown in bellow figure 9, agencies can view record of criminal after take an action of agents.

Security agencies can retrieve its information

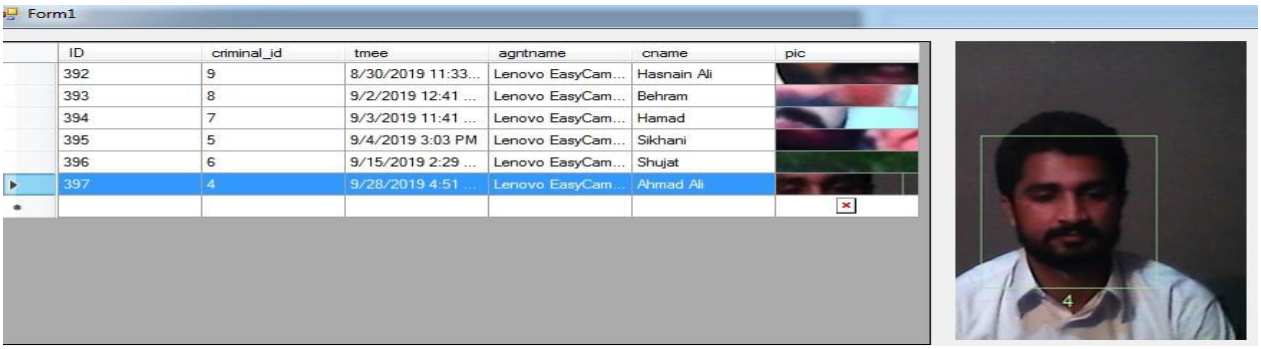
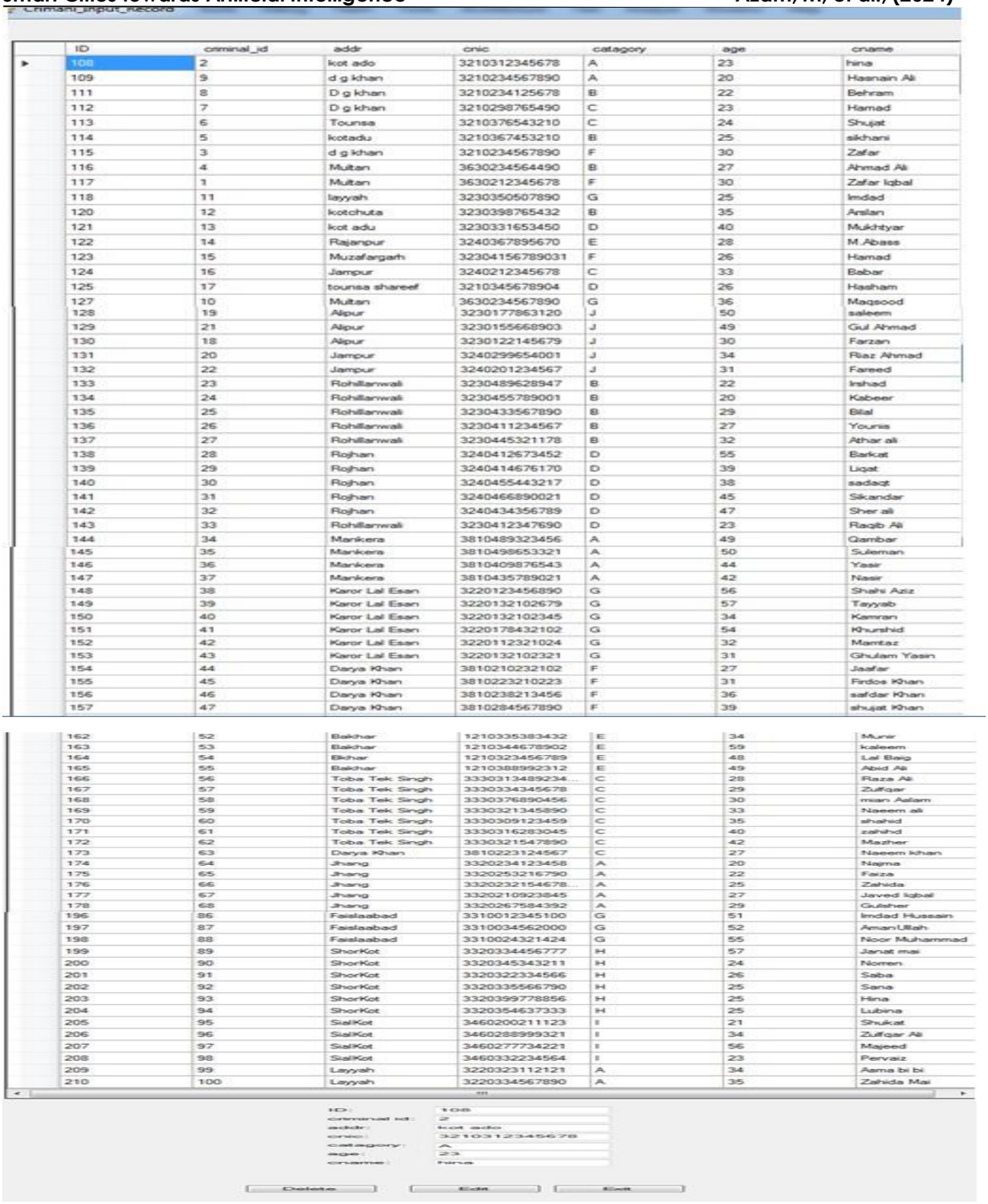


Figure 9.
Criminal record

Agents get input and then analyze and evaluate it, after evaluation if agents find criminal then it automatically alert agencies. For alerting agencies, agents maintain the record of criminalin the database. The maintained record of agents sends to the agencies by decisionmaking capability. That database work as shared database towards agencies, because agencies can view that criminal by the vision of agents with real time, in which area and in which condition that criminal present. For further improvement of that proposed method, we perform further experiment for test purpose. An agency saved information of hundred training images with its tracker ID for finding criminal which saved information present in figure 10.

Agency captured facial footage of 14 different persons with differentpositions, poses and distance shown in figure11.For better performance of face detection and recognition four angles face features extraction of human faces are necessary. Human face features are deeply explained in (19). If an algorithm work on four angles than its accuracylevel increased 100%, because if any one angle present than it will work efficient. In this proposed work algorithm, which is used in autonomous agent's recognized human faces by using four angles by webcam is 30; -30 degrees of in plane head rotations. Autonomous agents recognized each human faces completely, if any unknown face present show it as unknown not ignore it. Its time frequency is highlyaccurately worked under the different facial position and lightning conditions given bellow figure 12. But (20) is difficult to recognized under different lightning conditions, multiple faces and variations in facial position, so itsaccuracy is low 30% or less.



ID	criminal_id	addr	cnic	catagory	age	cname
108	2	kot adu	3210312345678	A	23	hina
109	9	d g khan	3210234567890	A	20	Hasnain Ali
111	8	D g khan	3210234125678	B	22	Behram
112	7	D g khan	3210298765490	C	23	Hamad
113	6	Tounsa	3210376543210	C	24	Shujat
114	5	kotadu	3210367453210	B	25	sikhani
115	3	d g khan	3210234567890	F	30	Zafar
116	4	Multan	3630234564490	B	27	Ahmad Ali
117	1	Multan	3630212345678	F	30	Zafar Iqbal
118	11	layyah	3230350507890	G	25	Imdad
120	12	kotchuta	3230398765432	B	35	Arslan
121	13	kot adu	3230331653450	D	40	Mukhtyar
122	14	Rajanpur	3240367895670	E	28	M.Abass
123	15	Muzafargarh	323041567890 31	F	26	Hamad
124	16	Jampur	3240212345678	C	33	Babar
125	17	tounsa shareef	3210345678904	D	26	Hasham
127	10	Multan	3630234567890	G	36	Maqsood
128	19	Alipur	3230177863120	J	50	saleem
129	21	Alipur	3230155668903	J	49	Gul Ahmad
130	18	Alipur	3230122145679	J	30	Farzan
131	20	Jampur	3240299654001	J	34	Riaz Ahmad
132	22	Jampur	3240201234567	J	31	Fareed
133	23	Rohillanwali	3230489628947	B	22	Irshad
134	24	Rohillanwali	3230455789001	B	20	Kabeer
135	25	Rohillanwali	3230433567890	B	29	Bilal
136	26	Rohillanwali	3230411234567	B	27	Younis
137	27	Rohillanwali	3230445321178	B	32	Athar ali
138	28	Rojhan	3240412673452	D	55	Barkat
139	29	Rojhan	3240414676170	D	39	Liqat
140	30	Rojhan	3240455443217	D	38	sadaqt
141	31	Rojhan	3240466890021	D	45	Sikandar
142	32	Rojhan	3240434356789	D	47	Sher ali
143	33	Rohillanwali	3230412347690	D	23	Raqib Ali
144	34	Mankera	3810489323456	A	49	Qambar
145	35	Mankera	3810498653321	A	50	Suleman
146	36	Mankera	3810409876543	A	44	Yasir
147	37	Mankera	3810435789021	A	42	Nasir
148	38	Karor Lal Esan	3220123456890	G	56	Shahi Aziz
149	39	Karor Lal Esan	3220132102679	G	57	Tayyab
150	40	Karor Lal Esan	3220132102345	G	34	Kamran
151	41	Karor Lal Esan	3220178432102	G	54	Khurshid
152	42	Karor Lal Esan	3220112321024	G	32	Mamtaz
153	43	Karor Lal Esan	3220132102321	G	31	Ghulam Yasin
154	44	Darya Khan	3810210232102	F	27	Jaafar
155	45	Darya Khan	3810223210223	F	31	Firdos Khan
156	46	Darya Khan	3810238213456	F	36	safdar Khan
157	47	Darya Khan	3810284567890	F	39	ahujat Khan
162	52	Bakhar	1210335383432	E	34	Munir
163	53	Bakhar	1210344678902	E	59	kaleem
164	54	Bkhar	1210323456789	E	48	Lal Baig
165	55	Bakhar	1210388992312	E	49	Abid Ali
166	56	Toba Tek Singh	3330313489234	C	28	Raza Ali
167	57	Toba Tek Singh	3330334345678	C	29	Zulfqar
168	58	Toba Tek Singh	3330376890456	C	30	mian Aslam
169	59	Toba Tek Singh	3330321345890	C	33	Naeem ali
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171	61	Toba Tek Singh	3330316283045	C	40	zahid
172	62	Toba Tek Singh	3330321547890	C	42	Mazher
173	63	Darya Khan	3810223124567	C	27	Naeem khan
174	64	Jhang	3320234123458	A	20	Najma
175	65	Jhang	3320253216790	A	22	Faiza
176	66	Jhang	3320232154678	A	25	Zahida
177	67	Jhang	3320210923845	A	27	Javed Iqbal
178	68	Jhang	3320267584392	A	29	Gulsher
196	86	Faislaabad	3310012345100	G	51	Imdad Hussain
197	87	Faislaabad	3310034562000	G	52	AmanUllah
198	88	Faislaabad	3310024321424	G	55	Noor Muhammad
199	89	ShorKot	3320334456777	H	57	Jarrat mai
200	90	ShorKot	3320345343211	H	24	Nomen
201	91	ShorKot	3320322334566	H	26	Saba
202	92	ShorKot	3320335566790	H	25	Sana
203	93	ShorKot	3320399778856	H	25	Hina
204	94	ShorKot	3320354637333	H	25	Lubina
205	95	SialKot	3460200211123	I	21	Shukat
206	96	SialKot	3460288999321	I	34	Zulfqar Ali
207	97	SialKot	3460277734221	I	56	Majeed
208	98	SialKot	3460332234564	I	23	Pervaiz
209	99	Layyah	3220323112121	A	34	Asma bi bi
210	100	Layyah	3220334567890	A	35	Zahida Mai

ID: 108
criminal id: 2
addr: kot adu
cnic: 3210312345678
catagory: A
age: 23
cname: hina

Delete Edit Exit

Figure10.
Input record of hundred people given by agencies

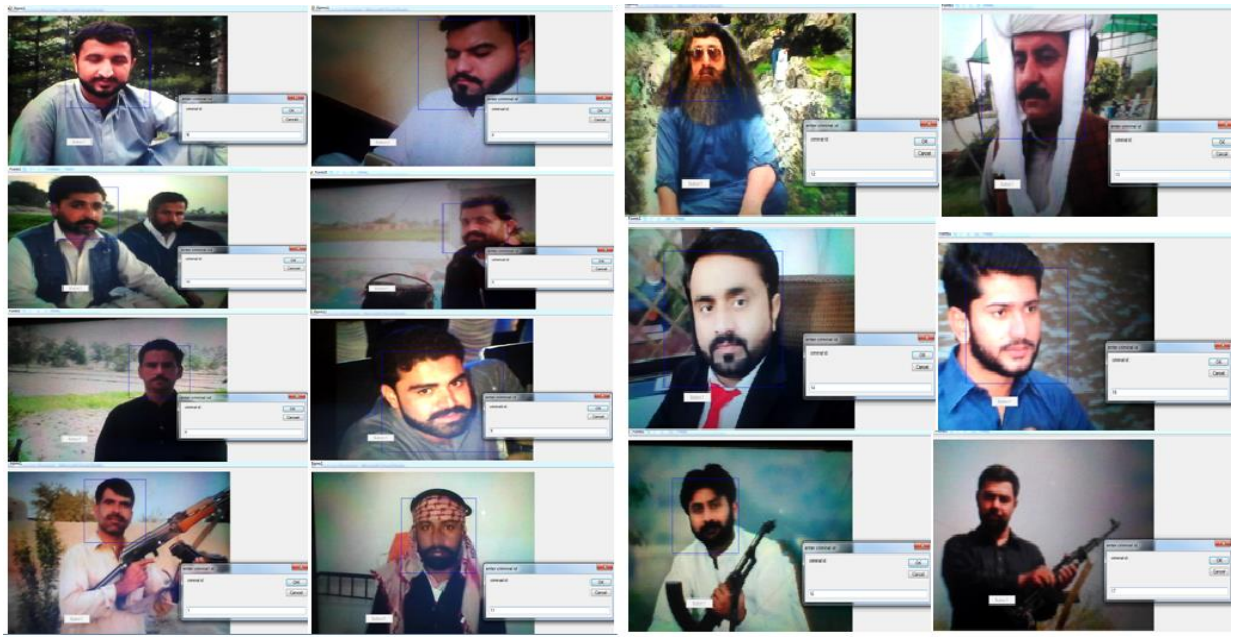

Figure11.
Sample Images of criminal

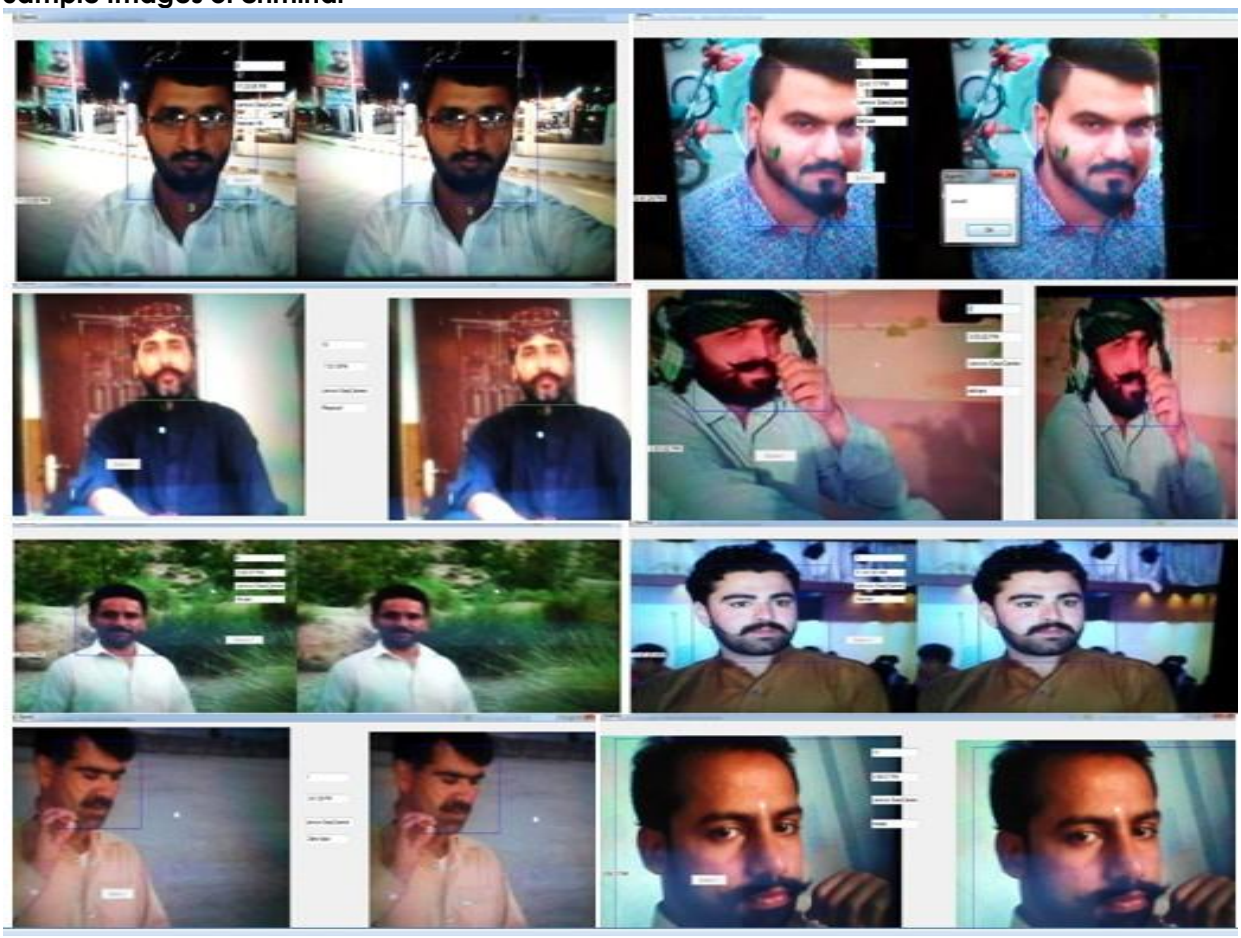

Figure12.
Criminals recognized by Autonomous agents

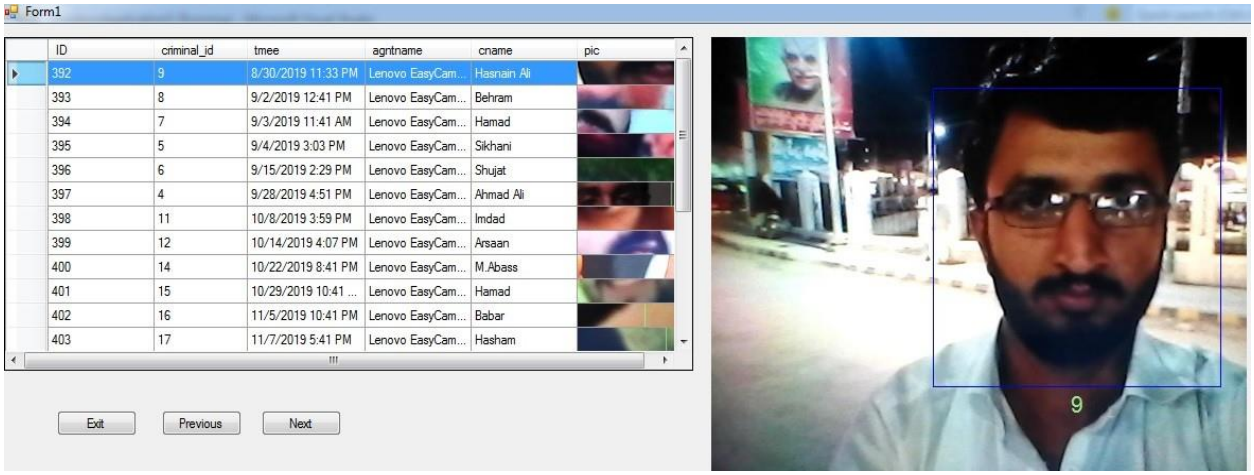

Figure13.
Output Given by Agents

CONCLUSION

Smart cities without having its components as autonomous agents are lacking best selection about their action and decisions. Itwill react wrongly and don't have ability to understand problem at environment in real time. That's why the autonomous agents are necessary for real time security and safety at smart cities. The smart cities that having conscious agents has capability to take action and real-time decision-making ability from previous experience. This paper used to solve drawbacks and limitations of pre-existing security agents at smart city. To overcome this problem a new model is proposed that work as autonomous agent for security at smart city. That proposed model has four stages. Agents get input from environment and understand itssituation from perceive stage. In analyzer it understands problem. At evaluation stage it finds the

similarity and dissimilarity between objects. In the last stage it reacts at real time. In future, the current framework will be helpful to paralyzed criminal by autonomous agents at any place.

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Notice: In accordance with ethical and privacy standards, all personal images used in this research paper are illustrative samples. Prior informed consent was obtained from all models and individuals featured in these images. The use of these images strictly adheres to ethical guidelines to ensure the privacy and rights of the individuals depicted. The author takes full responsibility for the legal implications of using these images, ensuring that all necessary permissions have been secured and that the images are used in compliance with relevant laws and ethical standards.

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