

Framework for Decision Support Based on Hybrid of Ad hoc Intelligent Dynamic System

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Abstract: Support decision making is an important field to saving money, minimize infrastructure cost and satisfy assurance of quality. So, surveillance of organizational infrastructure and its activities based on distributed sources and detection in real time became typical in unrestricted safety and services distribution. This research proposes a construction of a hybrid agent system to achieve processing of the integrated knowledge in dynamic environments. The knowledge acquisition for this complex environment will be tackled via distributed defecated sensors. The framework of the proposed system was designed and implemented using a hybrid intelligent dynamic surveillance system (HIDSS) that senses and tracks data and its source via for Radio Frequency Identification (RFID) and wireless sensor networks (WSNs). The aim of the proposed system is to construct a mathematical modeling via designing data warehouse architecture for Iraqi Oil Products Distribution Company. The proposed system affects the control production using intelligent sensing in real time. Big data was controlled via the cloud of the proposed system.

Keywords: *RFID, WSN, Decision Tree, Surveillance, Support Decision, Data Warehouse.*

Introduction

“Micro electromechanical systems are enable the development of small, inexpensive, wireless sensor nodes [1]” via engaging sensor networks to maintain daily requests and applications. When these sensor networks are distributed in oil

industry environment, it can facilitate the opportunities for management to surveillance the process engineering, production, distribution, performance progress, and enhance decision support making. Therefore, in order to aid and facilitate this management and offer support to decision making concerning production, risk surveillance, and efficient system for oil distribution. This research methodology presents a road map for implementing surveillance detection system via designing a prototype that reflects the mixing and integration of real ad hoc WSN and RFID. This also evaluates the above surveillance system via designing and implementing data warehouse architecture and designing hybrid intelligent predicting.

2. Aims and contribution

The design and implementation of a hybrid intelligent system to support the decision-making of a productive environment using the integration of WSN and RFID is a decision support for the enterprise to save money, and reduce the infrastructure cost and maximize its quality assurance. Therefore, surveillance the organization's infrastructure and activities based on distributed resources and real-time detection, to become a typical distribution of safety and unrestricted services. This research suggests collaborating construction factors that promote integrated knowledge in dynamical environments. Knowledge acquisition of this complex environment will be processed through distributed detectors. In addition, the proposed system framework will be designed and implemented using HIDSS. WSNs are the

objectives of the proposed system which are build a mathematical model using the following steps:

- Design and implementation of data warehouse structure for the proposed project.
- Integrated repository of data obtained by WSN-RFID.
- Design structure for detection distribution.
- Extract knowledge from these repositories of predictive data models and evaluate planning to enhance community production.
- Contribute to the production of intelligent sensor control using real-time via RFID.
- Use the cloud system to store and control knowledge. Where the beneficiary of the project is Iraqi Ministry of Oil.

3. Project Description

Monitoring, analysis and extrapolation of data on petroleum products (distribution, monitoring, data analysis, decision assistance)

What does the Beneficiary expect from the project?

- Control the movement of the product and eliminate the phenomenon of smuggling and trading and manipulation.
- The possibility of determining quotas for citizens according to need and real consumption and the policy of the branch in the processing of during the identification of categories that deserve support from others.
- Ensuring the arrival of the citizen's share of the beneficiaries.
- Control the performance of squares and all distribution outlets in an electronic manner.
- Reduce dependence on imports and to be satisfied with local production.
- To keep abreast of global development, reduce congestion in roads and reduce the phenomenon of environmental pollution and noise and to promote public transportation and government transport by reducing dependence on private cars.

- Obtain a real database of vehicles of all types including all the details which can be benefit from the security aspect of the country.

4. Literatures survey

[S. H. Alsamhi and et.al, 2018] [2], presents “a Survey and Future Prospects Greening Internet of Things for Smart Every things with A Green Environment Life.”

[Abida Sharif, 2018] [3], presents studies show that a very rare work is done on the combination of traffic congestion, IOT and ad hoc networks in terms of smart cities.

[Falah Alshahrany and et.al, 2016] [10], assume that using of “a variety of data fusion tools and techniques for big data processing poses the problem of the data and information integration called data fusion. The interrelated functional and hardware RFID-WSN integration is an essential aspect of the data fusion framework”.

[Hadi Habibzadeh, 2017] [12], depict proposal that “the Large-Scale Distributed Dedicated- and Non-Dedicated for contribution in Smart City Sensing Systems. Smart lighting and smart transportation promise to drastically improve the quality and efficiency of these services.”

[Abdelhamid Salihand Mohamed Salih, 2013] [8], presents “a research that review of Ambient Intelligence Assisted Healthcare Monitoring. This research focused on the concepts of AmI and Artificial Intelligence (AI) methods and data mining techniques”

[Jayavardhana G. and et. al., 2013] [9], presents, a research for “Internet of Things (IoT): As a vision, architectural elements, and future directions. Ubiquitous sensing enabled by Wireless Sensor Network (WSN) technologies cuts across many areas of modern day living”.[Jarred Martin, 2014] [13], offers a dissertation that

“design and implement Hybrid RFID Sensors for different applications. He depicts that the integration of these two fields of wireless sensor networks and RFID technology are two examples of the current move to ubiquitous computing and wireless sensor networks and has emerged as a tool for long term remote monitoring

for applications ranging from agriculture to military.”

5. RIFDS

“ The acronym RFID stands for Radio Frequency Identification, this technology has been around for the last seventy years [13] .It is an automated data collection, and enabling objects to connect through networks which use radio waves to retrieve, identify and store data remotely and Using intelligent barcodes to track items”. The components of RFID are tag, reader, antenna and station. “ In RFID the technology can be divided into two categories; Active and Passive and “the frequency ranges at which RFID tags and readers operate range from 128 KHz to 5.8 GHz, where the active tags would typically operate at the 2.4 GHz frequency band while passive tags operate at under 100 MHz [24]”.

6. Wireless Sensors Network (WSN)

Wireless sensor networks are used in many of the applications that organizations need to monitor their equipment and products, as well as to monitor personnel on such equipment in a large and open environment. The use of wireless sensor networks in such environments reduces risk and avoids all influences that reduce production and weaken it. These networks are distributed to all desired areas where such networks, as well as areas of production, processes, areas and sensitive environments. That the number of networks and energy needed for their work and how they are linked to each other and their life span is an important thing to pay attention to accurately. One of the important factors and problems that can significantly affect the role played by these networks in a given application and in improving performance is the number and distribution of those networks. The way in which information is derived from these networks is also a factor influencing the security of that information and the success of the application.

Differences between WSN networks and custom wireless networks (dedicated mobile networks) can be summarized as follows: [1]

- The number of nodes in WSNs is much larger than nodes in dedicated networks.
- The density of a WSN contract is large enough to measure a particular physical phenomenon.
- WSN can be fixed or moving.
- Battery exhaustion can lead to contract failure in WSNs.

- Limited power, computational and operational potential as well as limited memory.
- WSN nodes do not have a global identifier (ID) because of the large number of sensors and large loads.

The architecture of the sensor contract varies according to the environment in which it operates, including the equipment and the equipment used, and the architecture should aim to reduce costs and flexibility in the event of failures and malfunctions and to conserve the consumed energy as shown in Figure (1) next one:

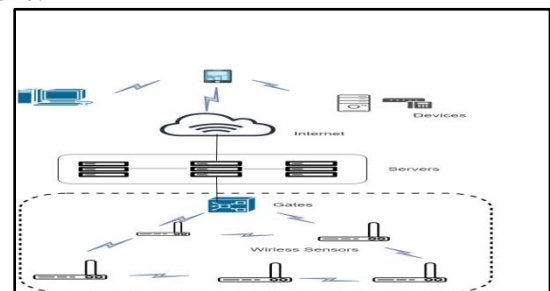


Figure [1] Generic WSN architecture

- 1- Sensor unit: It is a sensor and converter from analog to digital energy.
- 2- Processor: It consists of the communication unit and the memory or storage unit.
- 3- Unit of energy: the unit necessary to supply the node with the necessary energy.

Specific protocols are used for the purpose of maintaining communication and by network type.

Two layers are responsible of frequency selection and MAC protocol. These two layers are the physical layer which is mainly responsible for “frequency selection such as carrier frequency generation corresponding to checking RFID data list to make sure the task, signal detection, modulation, and data encryption are running well. While the data link layer is responsible of the media access control (MAC) protocol to minimizing the collisions between sensors [15]”.

8. Methodology of the proposed system

The detailed feasibility study is an important study for the project of processing oil derivatives by card and the fact that there are real indicators and clear estimates all confirm the possibility of success of the project privileged, as it is an economic project in its real description, it is also involves providing a better service reality commensurate with the ministry's aim to improve the quality of service provided to the

citizen, so the project not only generates direct financial returns but benefits in improving public services as well as administrative, regulatory, environmental and social improvements Security in efficient, and a short and standard time.

Research methodology can be summarized as follows:

1. Implementing surveillance detection system via designing a prototype that reflects the mixing and integration of real ad hoc WSN and RFID.
2. Evaluating the above Surveillance system.
3. Design and implementing data warehouse architecture.
4. Predicting system via designing and implementing of hybrid intelligent system.
5. Testing and Evaluation the system.

9. System Description:

The system is defined as the sum of electronic, mechanical and software applications to perform a specific technical work aimed at achieving specific goals in accordance with solid scientific foundations, since the integrated system software provides an integrated solution to ensure the success of the vision of the designer and the distribution company for oil products. The system achieves some goals, including:

- Information is provided to help decision makers better adjust distribution policy.
- Avoiding potential crises resulting from multiple causes.
- Administering citizens in order to ensure fair distribution and ensure their access to the product.
- Providing an excellent database that provides a clear vision for the Ministry's leadership.
- The possibility of adding any service through programming and can be deleted or modified.
- Regulate the citizen's consumption of the product according to a time table that helps him to organize his life.
- To save money on the printing of paper fuel cards.
- Provide periodic reports on the movement of products.
- Categorizing data available in servers according to our need.
- Ability to handle data through the web.

- Provide an integrated control system for tanker transport.
- Providing the easier ability to audit quantities and apply assets.
- Providing the inspectors with the easiest ability to control the performance of distribution ports.

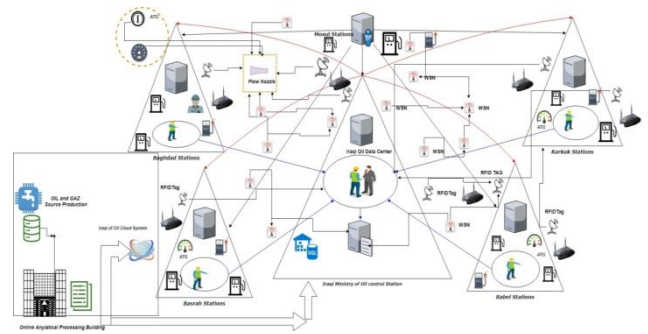


Figure [2] Environment of General Oil Products Distribution Company

10. General description and system requirements

Integrated control system with all accessories including fuel management system used for surveillance and control on the oil and management of the distribution process

The activities and equipment of the squares are composed of:

- Electronic receipt meter system.
- The system of measuring the level of the product in the tanks.
- Card system smart card type includes smart card - card reader in both types (Fixed and mobile with all the accessories and works necessary for the work of the system).
- All the operational and practical programs of the system and its related equipment (computers, servers, routers)...etc.
- Connect the video surveillance system (cameras) to the central control system of the system.
- Providing networking and data transmission requirements from distribution outlets (mobile terminals and vendors) to SIM card control centres are agreed upon with a government communication company or local to ensure the transmission of the signal efficiently.

- Collect data and edit reports on the movement of products and quantities in and out daily, weekly, monthly and yearly, as well as reports on tanks, video surveillance and reports operating and fault diagnosis etc. And periodically.
- Taking into consideration that the system will have the possibility to benefit from the advantage of prepayment in the future.

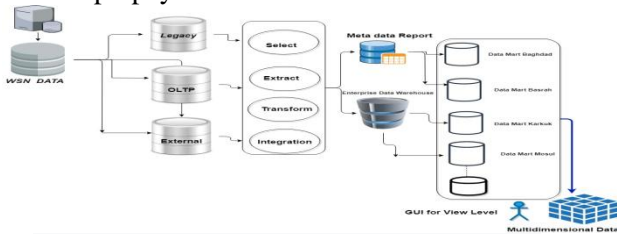


Figure [3] Architecture of the proposed Oil Productions and Distribution System

11. Automatic tank gauge system (ATM)

- 1- Ex-proof with convenient degree according to the location instruments in fuel stations.
- 2- Consist of measurement analysis unit, stick level sensors (stainless steel), intrinsically safe power supply.
- 3- Portfolio monitoring measurement: Product Volume, Volume Temperature, Ullage, Water level, Temperature, density (optional).
- 4- Delivery Measurement:
 - a. Including dispenser sales made during delivery process.
 - b. Automatic Historical Wet stock Reconciliation.
 - c. Tank volumes, deliveries and dispenser sales.
- 5- Screen with 3.5 inches (at least) with high resolution color screen with keypad.
- 6- Alarm when: high /low product, high water sudden loss, leak.
- 7- Used for underground – above ground storage tanks.
- 8- Accuracy: - product ± (0.25-0.5) mm / Water + (1 - 2) mm / Temperature ± 1 C^o with range (10 – 60) C^o.
- 9- The gauge type should be suitable to the install location.
- 10- Software (open system) with all accessories such as cables, junction box.....etc.
- 11- Full matching Operation with electronic control system.

11.1 Fuel smart card system

A. Smart Card Specification

1- Smart fuel card solution was designed to meet the architectural requirements as “(Offline operation, Throughput and Scalability, Security,

Availability, Robustness, Maintainability, Adherence to standards, Usage of well-proven products and components)”.

2- Special smart card for each oil products (kerosene and liquid gas, gasoline, gas oil).

3- Physical structure: -

- Made of high quality material.
- Operating temp. Range (0-50) co, resist to effect of humidity (10 – 90) %.
- Stand for (U.V light, X-rays, dynamic bending stresses, dynamic torsional stress alternating and static magnetic and electric fields).

4- Dual interface card (Contact- Contact less) integrated circuit cards type (smart card), used for data transmission, storage, and processing.

5- Fueling restrictions can be programmed into a fuel card to specify the following requirements:

- Volume allowed per transaction, per day and week. Days of the week and day card can be used.
- Number of incorrect PIN entries acceptable, Card lock-out period after incorrect PINs, etc.).

6- It can be optimized for one application or can integrate several different applications as (prepaid card) for future application.

7- Dimensions are normally ID-1 (full size).

8- Contain CPU: 8-32 Bit, comminute at 13. 56 MHZ, with memory: 1 KB (At least).

9- Contains a security system with tamper - resistance properties and provided with PIN code option and Personalization data for issuing card are encrypted from end to end.

B. Smart card reader specification:-

1. Two types fixed (on fuel dispenser) and portable handheld readers.
2. Operating system: Microsoft windows CE, or up (original) with multiple language (Arabic and English).
3. PC/SC compatible and Software support (Operating system) :(Microsoft Windows® XP, Microsoft® Windows® Vista, Microsoft® Windows® 7).
4. Processor: 400 MHz CPU (at least).
5. Data Interface slandered Bluetooth and WIFI, with option GPRS/ GSM, GPS.
6. Standards communication interface full speed USB (12bps), RS232 (up to 115200bps), etc.
7. Has screen with “3.5 inches with high resolution color screen or up, digital backlight Keypad and built-in speaker.

8. Provided with power switch and Has L.E.DS with displaying power-on, read/write and charge states.
9. Provided with built-in small printers.
10. Operate and save data of card reading at (off line) or (on line) state and capable to programmed into fuel card in addition to read it (read/write).
11. Supported with SIM CARD positions which need to its operation in addition to any way used for transmit data (secure and ensure way) that matching with all system design.
12. Operating temperature (0 – 65) co, storage temperature (-5 – 70) co.
13. Has integrated short circuit protection.
14. Standard battery (for portable reader): recharge able Li-ion battery, to be device working with 15 Hours when full charged (at least).
15. Contains a security system with tamper - resistance properties and provided with PIN code...
16. Provided with individual battery charger work on (220v, 50Hz) and charger for (12v DC which use in cars with its accessories).
17. Card read cycle not more than (50 ms).
18. Supplied all its necessary accessories for Installation and operation.

11. Decision Rules and Decision Tree

It is a data mining technique used for classification systems and predicting objectives. This technique is based on classifying entities via constructing a tree of production rules. It is non-deterministic algorithm classified in to two types depending on the entities characteristics which can be general properties or specific and special one. So, it can be top-down or bottom up classification. This proposed system predicts knowledge from big data repository using this data mining technique after training data. The data can be classified to training and validation data. The proposed methodology will enhance decision tree methodology using C4.5, CART, CHAID and QUEST. As shown in figure [4] Sample of Decision Tree Structure for Predicting Risk.

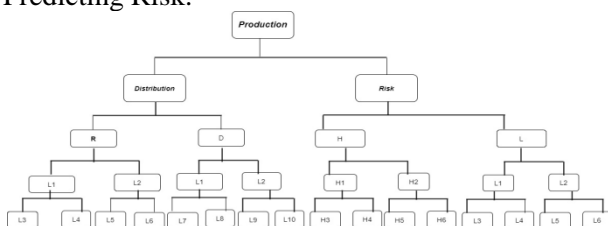


Figure [4] Sample of Decision Tree Structure for Predicting Risk

11.1 Data analysis and clustering

Due to the huge data, one of the rigid artificial neural networks tool used for data analysis is Self-Organizing Map. “The principal objective of SOMs is to transform a complex high-dimensional input space into a simpler low-dimensional and discrete output space by preserving the relationships (i.e. topology) in the data [16, 17]”.

A. SOM Architectures

"SOM is an unsupervised learning scheme. It is a form of learning by observation, rather than learning by examples takes place to discover the underlying hidden patterns in the data set [19]". Self-organizing maps learn to cluster data based on similarity, topology, with a preference (but no guarantee) of assigning the same number of instances to each class. Self-organizing maps are used both to cluster data and to reduce the dimensionality of data. It” applies a competitive learning rule where the output nodes compete among themselves for the opportunity to represent distinct patterns within the input space [18]”. During the learning process in the feedforward nature of SOMs allows an information flow in only one direction, without looping or cycling, from the input nodes to the output nodes. Note that every node in the input layer is linked (with weights) to every node in the output layer, which makes an SOM a completely connected network [17]. The architecture of an SOM includes three distinctive processes, which can be précised as follows [18]:

(i) *Competition*: “The output nodes in a self-organizing map compete with each other to best represent the particular input sample”. The representation is measured using a discriminant function, where an input vector is compared with the weight vector of each output node. A number of different functions to conclude the winner where the most often used one are the Euclidean distance.

(ii) *Cooperation*: “neurons dealing with closely related pieces of information are close together so that they can interact via short synaptic connections [18]. SOM is a topographic organization in which nearby locations in the output space represents inputs with similar properties”. The winning node determines the spatial location of a neighborhood of cooperating nodes. These nodes, sharing common features, activate each other to learn something from the same input.

(iii) *Adaptation*: “The weight vectors of the winner and its neighboring units in the map are adjusted in favor of higher values of their discriminant functions. Through this learning process the relevant nodes become more similar to the input sample [20]”.

B. SOM Layers

The SOM network typically consists of two layers of nodes, the input layer and the output layer. In SOM the input layer of source nodes is directly connected to the output layer of computation nodes without any hidden layer [17]. The nodes in the input layer denote the attributes (features) or, more generally, the variables contained in the input data. Each piece of input data is represented by an m-dimensional input vector, $x = (x_1, x_2, \dots, x_m)'$, whose elements indicate the attribute values of a particular dataset [17]. This will give equal chances to all the attributes [21] and improve the numerical accuracy [22]. “Euclidean distance between a sample x, chosen randomly from the input dataset and all the weight vectors at iteration t is calculated by using the following formula.”

$$d_i(t) = ||x(t) - w_i(t)|| = \sqrt{\sum_{j=1}^m (x_{ij} - w_{iji})^2} \quad i=1, 2 \dots n \dots \dots \dots (1)$$

Note that the weight vector w_i of each output node (i) has the same dimension as the input vector x. At the end of the similarity matching process, the best-matching (winning) node (c) at iteration t is determined by using the minimum distance Euclidean criterion:

$$c(t) = arg\{ ||x(t) - w_i(t)|| \} \dots \dots \dots (2)$$

A neighborhood function $h_{ci}(t)$ where i denotes the index of the neighboring unit. The most preferred function of this type is the Gaussian function which decreases in both the spatial domain and time domain, where d_{ci}^2 denotes the lateral distance between the winning neuron c and the excited neuron i, and s(t) represents the effective width or radius of neighborhood at iteration t. [23]:

$$h_{ci}(t) = exp\{-\frac{d_{ci}^2}{2\sigma^2(t)}\} \dots \dots \dots (3)$$

The following formula presents the update rule for the weight vector $w_i(t+1)$ at iteration t+1 of unit i [22]:

$$w_i(t+1) = w_i(t) + \alpha(t)h_{ci}(t)[x(t) - w_i(t)] \dots \dots \dots (4)$$

c. SOM algorithm of the proposed system

SOM algorithm for the proposed system can be summarized by the following steps:

- (i) Choose the dimension and size of the output space. Assign random values the initial weight vectors $w_i(0)$.
- (ii) Randomly select an input vector $x(t)$ from the training data set.
- (iii) “Compute the Euclidean distances between the input vector and each output node’s weight vector and find the best matching node $c(t)$ ” at iteration t by applying the minimum distance criterion using equation (2).
- (iv) “Adjust the weights of the winning node and its neighborhood according to their distances to the winning node by using the update formula where $h_{ci}(t)$ will be equal to 1.”
- (v) Set $t = t + 1$. “Adjust the neighborhood size and the learning rate.”
- (vi) Keep returning to Step 2 until the change of the weights is less than a pre specified threshold value or the maximum number T of iterations is reached. Otherwise stop.

12. Cube representation of multidimensional data

“A data warehouse is based on a multidimensional data model which views data in the form of a data cube. The dimension tables such as item: (item_name, brand, type), or time (day, week, month, quarter, year).” In data warehousing literature, an n-D base cube is called a base cuboid. The topmost 0-D cuboid, which holds the highest-level of summarization, is called the apex cuboid. Fig [5] depicts a frame of cub-id.

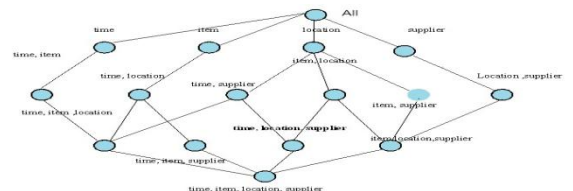


Figure [5] A Frame of Cuboids

13. Results

The results of the proposed research based on statistical data obtained from the real daily of petroleum products such as white oil, automobile fuel, gas and automobile oils, as well as how these products are distributed. All these data were constructed via WSNs and RFID surveillance. This study also includes the identification of potential risks to the infrastructure of oil installations and controls the conditions surrounding these products to ensure their safety. Data Marts are geographically distributed according to the objectives of each to serve specific groups of populations. So, these

data marts are distributed system and have the distributed system concepts.

From the previous figures we have observed the need for commitment to all dimensions of infrastructure environment and production conditions surrounding the oil institution, and to identifying potential risks that can reduce the efficiency of the system. The Iraqi oil corporation includes several locations distributed geographically to provide the service for the distribution of petroleum products according to population ratios. The attempt by some to manipulate standards, equipment and production can also be a major reason for building a model capable of overcoming these problems and constraints and avoiding potential risks from intentional and unintentional misalignment. To construct the proposed model, the conditions surrounding all warehouses, containers, reservoirs, refineries, fuel stations, dimensions and infrastructure were studied, taking into account the surrounding weather conditions such as wind, temperature and possible weather forecasts throughout the year. Due to these reasons, there is a need to determining the number, location and nature of monitoring and sensing devices and the appropriate distances between them. The proposed system is an interactive between the suggested sensors and control units of the infrastructure of the oil production institution.

As shown in figure [6], the best validation performance is [0.052382] will be at epoch 70 after training the proposed system while cross entropy is less than $[10^{-1}]$.

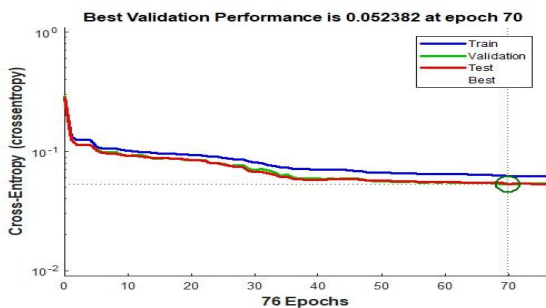


Figure [6] Validation Performance

Error histogram for training system at epoch 76 for more than [10000] instances was [0.04642] as depicted in figure [7].

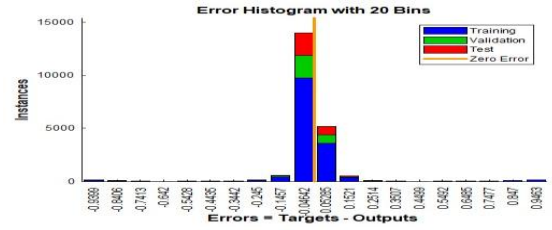


Figure [7] Error histogram with 20 Bins

Using SOM, the accuracy found using confusion matrix is [96.7%] for all training samples. This result indicates clearly that the error and misclassification is very low. Figure [8] depict the training and validation of confusion matrix for the proposed system.

Training Confusion

Output Glass	8.2	3	9	87.2%
	1.6%	0.1%	0.2%	12.8%
	11	10	7	35.7%
	0.2%	0.2%	0.1%	64.3%
	17	267	4634	94.2%
	0.3%	5.3%	91.9%	5.8%
	74.5%	3.67%	99.7%	93.8%
	25.5%	96.4%	9.3%	6.2%
24	1	5	80.0%	
2.2%	0.1%	0.5%	20.0%	
3	1	1	35.7%	
0.3%	0.1%	0.1%	64.3%	
4	39	1002	95.5%	
0.4%	35%	92.8%	4.1%	
77.4%	2.4%	99.4%	95.0%	
22.6%	97.6%	0.6%	6.2%	

Output Glass

Target Glass

1	85.2%
1.8%	14.8%
17	30.6%
0.2%	69.2%
22	94.7%
0.3%	53%
74.5%	94.0%
25.5%	5.9%

Test Confusion

Output Glass	2	84.0%
	1.9%	16.0%
	3	16.7%
	0.3%	83.3%
1	96.5%	
0.1%	4.4%	
84.0%	94.5%	
16.0%	5.21%	

Output Glass

Target Glass matrix

14. Conclusions

Real time of decision support for organization infrastructure and its activities after intelligent surveillance became a significant filed in services distribution of unrestricted environment. Today support decision making is an important theme to satisfy assurance of quality of such services. This research proposes a hybrid intelligent agent system to achieve processing and controlling of the knowledge integration in these dynamic environments. The knowledge acquired have been tackled via distributed defecated sensors and using a hybrid intelligent dynamic surveillance system (HIDSS) that senses and tracks data and its source via Radio Frequency Identification (RFID) and wireless sensor networks (WSNs). Huge knowledge was controlled and classified via data mining technique using self-organization map (SOM). The convolutional matrices of the processed knowledge depict a high classification accuracy rate. Decision tree designed and implemented to support decision making. The contribution of the proposed system affects assurance of quality of the processed environment.

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Target Glass

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