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# A Theoritical Approach for Optimal Utilization of Distributed Consensus Algorithm for Various Applications

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**Abstract**

In this paper, we are proposing a novel approach to optimize the distributed consensus algorithm in the decision making concept and application layer are been effectively in IoT based Wireless sensor networks (WSN). In this we are addressing 3 problems. First one is based on the distributed consensus algorithm we can optimize the decision in power grids to take decision depending on the supply and demand. Second one is application layer can be used to monitor, identify the interdependencies in the cross layers and QoS. Third one WSN can be used to gather the information of the sensor nodes and the same can be processed for further. The distributed consensus and application layer can be used optimistically to make decision in the different application.

***Keywords:*** *Wireless Sensor Networks, Internet of Things, Decision Making, Application layer.*

## 1. Introduction:

During the past few years, various kinds of centralized control methods were proposed to optimize the microgrid operation, however, due to the collection and transmission of global information, which is costly and easy to suffer from single-point-failures, it is gradually replaced by distributed control. the distributed consensus-based voltage control strategy was introduced to solve the problem of reactive power sharing in inverter-based microgrids with dominantly inductive power lines. In [6], the consensus problems was presented for directed networks of agents with external disturbances and model uncertainty on fixed and switching topologies. For more studies of distributed consensus control, please refer to [7]-[10] and the references therein. In actual power grids, the line transmission losses are in-evitable, and the losses will increase with the elongation of the transmission lines. In the existing references, the transmission losses were taken account into the economic dispatch [32]-[33], and multi-terminal high-voltage DC systems [34]. Especially in [32], the distributed consensus strategy was also involved, however, the energy storage systems were not considered. In [33], the quadratically constrained program method was used to solve the problem of dynamic economic dispatch, but it did not concern the distributed strategy and energy storage systems. Thus, it is imperative to investigate the line transmission losses problem with energy storage systems by using distributed consensus strategy.

Based on the above analysis, in this paper, a new distributed consensus algorithm is proposed to solve the problems of power supply-demand balance by assembling the energy storage systems and considering line transmission losses. If the net total active power in the microgrids is nonzero, the redundant power will be charged in energy storage systems, otherwise, the energy storage systems should discharge the corresponding power to maintain the supply-demand balance. Furthermore, the power losses of line transmission can also be compensated by energy storage systems.

The main contribution of this paper is a fully-distributed consensus algorithm for multiple integrator agents, with arbitrary order, under a general directed graph. Specifically, we show that a consensus algorithm with a simple static compensator structure can achieve consensus, in the sense of (2), using only position-like states from neighboring agents without global gain dependency in the network. This relaxes the limitations of the above relevant literature by removing the requirement of relative measurements of higher-order state variables or the introduction of additional dynamic systems. The key tool in our approach is an appropriately designed similarity transformation that transforms the closed loop system into simpler similar dynamics for which consensus can be shown without conservative topology-dependent conditions. We also show that the proposed algorithm is robust to constant communication delays, and provide the consensus state (with and without communication delays) which clearly shows the influence of the control gains, the delays, and the interconnection topology on the final state of the multi-agent system.

Modern applications are made up of multiple components at different layers of the application stack such as web, application and database servers. These components can be deployed on diverse cloud infrastructure including virtual machines, containers and bare-metal servers and potentially in a multi-cloud environment. The diverse and highly dynamic nature of both the cloud services and application workloads introduces several challenges for CSBA providers. One of them is the identification, root-cause analysis and resolution of ASLA violation.

With the recent revolution of robotics, wireless sensor networks (WSN) and Internet of Things (IoT), more and more complex applications of monitoring and storage are being integrated with robotics to perform autonomous sensing and actuation. Especially, the added feature of cloud infrastructure implies less dependence on human input and more support from ubiquitous virtual resources. The paradigm is known as "cloud robotics". First coined by Google in 2010, the term refers to an evolutionary upgrade from networked robotics to overcome its limitations by leveraging the benefits of cloud computing technologies [1]. In fact, the introduction of cloud robotics has produced a shift in the modes of robotic applications. At the turn of the century, the manufacturers prepared robots for carrying out repetitive tasks with accuracy. Today, robots are capable of solving complex problems and making context-aware decisions in uncertain environments. These operations are aided by information from WSNs and assistance from the cloud.

in order to prevent the failure of a packaging task, a surveillance subsystem is incorporated, which monitors the status of the robots and the robot manipulator. When an unusual situation occurs, the system will sound an alarm and notify the engineers. The proposed system will improve the efficiency of e-fulfillment and reduce the labor that is necessary, while also providing customers with real-time information about their packages. In the IoT-based automated e-fulfillment packaging system, in this paper, we propose a three-dimensional adaptive Particle Swarm Optimization (PSO)-based packing algorithm which mainly deal with the packing process of the distribution processes. The algorithm decides on the optimal arrangement of items as well as a packing sequence, and the results are sent to each robot in the proposed system.

Aiming at this issue, it is necessary to monitor the service performance of key components in coal production system under the complex and severe working condition. Take coal cutter for example, the service condition parameters include electricity and temperature of cutting motor, the electricity and temperature of traction motor, inclination of body and inclination of rocker arm. Besides, the related operational information of start time, stop time, flow capacity of coal and roof pressure is recorded.

Tremendous development in electronics and miniaturization has opened doors for the manufacturing of new type of smart devices and sensors which are the integral part of IoT. These devices collect the data from their environment, communicate with each other or transfer it to the clouds for analytics and decisions. The connectivity among things or smart objects is mostly achieved through different wireless communication technologies (Wi-Fi, 3G, 4G, 802.15.x) and supporting protocols which are employed pervasively for smart monitoring and control applications [1-3]. This arrangement opens a new era of intelligent applications and a huge number of smart services that can bring substantial impact on human lives and boost economic growth [4]. Assisted healthcare, smart homes, smart cities, smart transportation, smart grids, smart irrigation, security, and surveillance are a few known examples. These applications generate a large volume of data that needs to be analyzed at right time to take appropriate decision. The end devices or smart objects which are resource constrained and are not capable of analyzing the collected huge amount of data, transfer it to the computing clouds over the Internet for further analytics and decision support. While transferring the data over the Internet, different types of security issues can arise like data integrity, eavesdropping, vandalism, data tampering etc. The main reason behind these security breaches is that the security and/or privacy of involved devices and related applications is not focused primarily during design, development and implementation phases. Privacy and secrecy of the user is also compromised when the sensitive and critical information is gathered and stored without owners' permission [5]. Such situations can lead towards damaging consequences.

## 2. Literature Survey

This algorithm is used to make decision towards the supply-demand in power grids, the algorithm is used to gather information from the near by agents and by keeping these information it will be used to determine the delays in communication presence. The application layer isused to monitor the performance, identity as well interdependencies of cross layers.

[1]-[3]. Application layer is used in QoS analysis. In this IoT is used via Cloud Computing in the helath monitoring platform. In this IoT is used and the application layer and decision making layer decides which customer which product and their bin size to be done and sent via IoT for further processing [4]-[6], [21]-[23]. In this 7 layers has been used to support the data management and maintain the decision making in order to avoid error free functionalities in fully mechanized system in this the algorithm is used to make decision from the data received from the data analytics via IoT [7],[8],[19],[20]. In this from the data analytics application layer has to make decision which signal to be ON/OFF. Using the Application Layer and decision making concepts has been used to encrypt the data. A study has been done to analyze the work on delivery models and deployjment models using the Cloud. [9]-[10]. In WSN without using IPs they have tried using VPNs for data collecting or sharing of information. WSN and RFID enabled IoT analsis has been done [18]. In IoT Time frequency analysis has been used to transmit the image signal and image processing is used by DWT and STFT algorithms to analyze the images and their quality. IoT is been used in MQTT, AMQP and CoAP and decides which to be used and the analysis saya that CoAP is better [11]- [15]. Conventional WSN doesn't work properly and SDWSN routing is operated in the controller and it establishes the distance info and comutes the closest path to transmit data for each node and proceeds further. WSN in physical layer and MAC layer using IPv6 for home automation. In this using numerical calculations related to the SNR and channel capapcity battery life of IoT sensors has been increased [16],[17],[20]. The convergence rate and time analysis of a fault-tolerant consensus algorithm that we proposed in [1] is carried out for asynchronous and synchronous partially connected networks with delay on communication paths. The results are also extended to the case of networks with timevarying underlying graph topology. [23]

## 3. Distributed Consensus Algorithm:

In this subsection, the distributed consensus algorithm will be introduced to solve the power compensation problem of transmission losses with energy storage systems. The charging/discharging power of the energy storage systems must satisfy the constrain conditions introduced in (8), and the transmission loss power is replaced by the transmission loss rate λ multiplied by the charging/discharging power of energy storage systems. The updating rules for agents' coordination are represented as

$$\begin{cases} r_i^{k+1} = \sum_{j=1}^{N_i} d_{ij} r_j^k + \delta P_{D,i}^k, \\ P_{B,i}^{k+1} = \begin{cases} P_{B,i}^{\min}, & \Theta < P_{B,i}^{\min}, \\ \Theta, & P_{B,i}^{\min} < \Theta < P_{B,i}^{\max}, \\ P_{B,i}^{\max}, & \Theta > P_{B,i}^{\max}, \end{cases} \\ P_{D,i}^{k+1} = \sum_{j=1}^{N_i} d_{ij} \left[ P_{D,i}^k + (P_{B,i}^{k+1} - P_{B,i}^k) \right], \end{cases}$$

Where $\Theta = \frac{a_i - r_i^{k+1}(1+\lambda_i)}{2b_i}$, with the initial value $P_{D,i}^0$ and $P_{B,i}^0 (i = 1,2,\ldots\ldots,N)$, the initial value of IC can be calculated by

$$r_i^0 = a_i - 2b_i P_{B,i}^0.$$

It should be noted that the proposed control algorithm is implemented through a microgrid framework, in which the agent updates local information and exchange information with its neighbors, and finally all agents converge to a same value. By setting the initial values of total net active power PD and energy storage power PB, the initial value of IC can be iterated by P0 B,i in the present moment. In the next iteration, equation (9) will be used for agents to update information from its neighbors,

## 4. IoT – Based Automated e-Fulfillment Packaging System

Packaging is an important activity in distribution systems, good packaging ensures the safe and efficient delivery of an item, in Sound Condition, to the ultimate consumer. A good packaging system in an e-fulfillment warehouse has to be fast, flexible and low-cost and should include good customer communication.

### Frame work of the System:

In network architecture of the proposed IoT based automated e-fulfillment packaging system is shown in figure 1. It consists of four layers, the data collection and conversion layer, the packaging management layer, the decision making layer and the application layer. The data collection and conversion layer connect the sensors to the machines, the customer orders, the factory information, and the merchandise information. The sensors allow the robots to recognize merchandise, to move in the factory environment, and to detect unusual situations. A factory environment map and the merchandise information can be collated autonomously by robots or be constructed mutually by human beings. In the data collection layer, customer orders are received, stored and managed for packaging. The collected data is first computed locally and then converted into useful information which is transmitted to the next layer. In the packaging management layer, the IoT based cyber network connects each robot and machine. It is built and updated according to the working status feedback of the robots. The intelligent algorithms in the decision making layer decide how the devices in the system perform. The scheduling and replenishment algorithm calculates the schedule of orders and the replenishment sequence. The packing algorithm decides the size box that should be chosen, and how best to arrange the merchandise in the box.

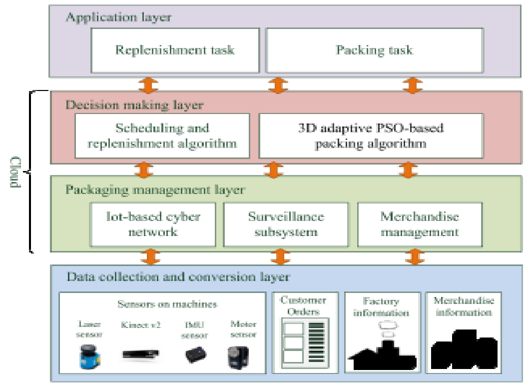


**Fig. 1 Architecture for Frame work of System**

### Decision Support Feedback Control Layer:

Figure 2 represents the decision making control layer. The Multi-Objective intelligent maintenance decision making model is established to achieve the aims of the production, safety and the maintenance economy by considering overhauling period, residual life threshold and spare part storage. A decision-making model is constructed to obtain the optimal solution of distributed system based on the improved non-dominance sequencing genetic algorithm. On the basis of that, the influence of different controllable parameters on the maintenance decision result is analyzed.

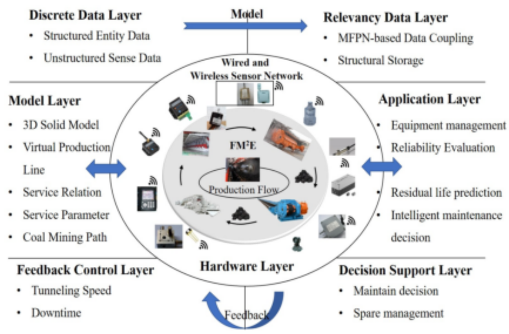


**Fig. 2 Decision Making Control Layer**

The decision-making process of time-critical applications entails readiness of real-time, accurate and secure data. It requires a low network latency, properly authenticated end devices, legitimate intermediary devices, encrypted communication, encrypted storage of data, ensured privacy mechanisms and so on. However, in IoT environment, the devices may be faculty, insecure or illegitimate. Hence the data collected from such IoT devices may not be trustworthy and can't be used in critical decision making. In such scenario, a faulty or a misbehaving end device (IoT) being used to take physiological readings or vital signs such as blood pressure (BP), body temperature, ECG, and Oxygen saturation of an elderly assisted patient can result in causality if the decisions are made on such untrustworthy information. The problem may arise even though, the device is properly authenticated and data privacy and integrity is ensured by using some cryptographic techniques. In order to solve this issue and to make dynamic domain adaptive security solution. The figure 3 sows the remedial method to over come the issues addressed by the existing method. In this the frame work will first dynamically select the domain-specific parameters and then values of those selected parameters will be gathered using direct observations. Indirect observations may also be used in trust computation if needed. Along with the trust, the system will also compute risk level. Based on the trust and risk values, the system will take the decision to forward trustworthy information to healthcare service providers for necessary actions.

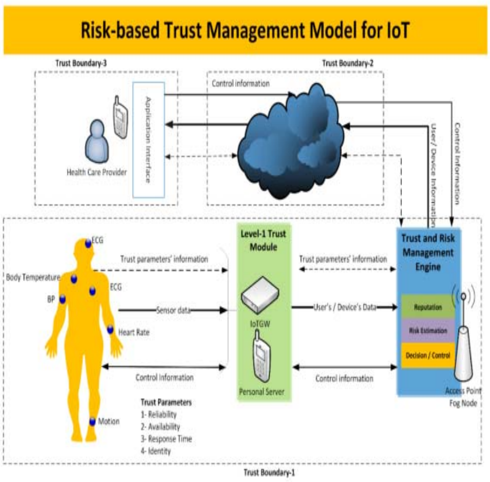


**Fig. 3 Porposed Risk Management Framework Architecture**

## Clustering at Spatial Scale: Trajectory Clustering:

A flow can be identified when a group of aircraft exhibits the same spatial pattern within the same time interval. In this module, a trajectory clustering scheme is developed to identify spatial patterns of aircraft movement as the first step towards flow identification. Clustering is an unsupervised learning method that aims to identify groups of similar observations in a dataset without prior knowledge about the existence of these groups or about how the observations are distributed among them. In the trajectory clustering problem, the goal is to find groups of similar trajectories in the spatial dimension, which are referred to as a *trajectory pattern*.

## 5. Application Layer

For example DTNs store information in the Bundle Layers and transmit it when the channel conditions do not severely affect communications. No encoding mechanisms at the physical level are either integrated or considered. In that case the idea is to apply *Forward Error Correction* (FEC) Mechanisms above the bundle layer, therefore moving the complexity to the application layer, creating what in Literature is called the *Application Layer Coding*. The advantages of this approach are obvious: firstly, the Hardware on-board must not manage complex encoding approaches, and, secondly, there is a gain in terms of Flexibility: the encoding parameter changes and/or other possible reconfigurations can be achieved via software, automatically.

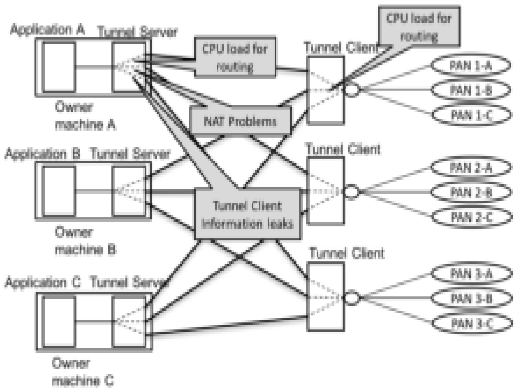


**Fig. 4 Problematic Implementation**

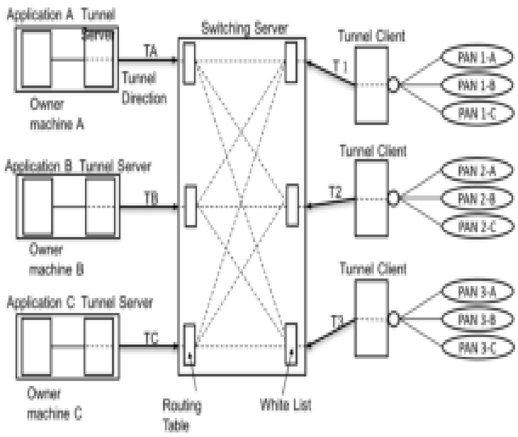


**Fig. 5 Switching Server to Solve Problems**

We note that certain problems arise when we naively realize the principle of the L2-VPN discussed above, as shown in figure 4. On the PAN side, the customer premises equipment (CPE) host on which the tunnel client runs is not expected to have a powerful CPU, and the multiple tunnels and routing functions present a considerable load to the CPU. On the data center side, the host machine that is possessed by an owner invokes both the data collecting application and the tunnel server, again creating a CPU power problem. Furthermore, if the host computer is on the owner's premises and not at the data center, there may be a NAT, which is likely to reject a tunnel establishment request from the Internet side. From a security point of view, one concern is that CPE information, such as the IP address, will leak out to the owner side, and a fake tunnel creating request attack on the owner host can occur.

We therefore introduce a switching server, as shown in figure 5, to solve the problems mentioned above. The tunnel server and tunnel client create only one L2-tunnel to the switching server. The request direction is from the tunnel server or client to the switching server. At this time in the process, the tunnel server is no longer a server; however, according the principle we have discussed thus far, we continue to refer to this function block as the tunnel server. The problems of NAT and tunnel client information leaks are solved by the tunnel request direction being reversed on the tunnel server side.

## 6. Data Delivery and Processing:

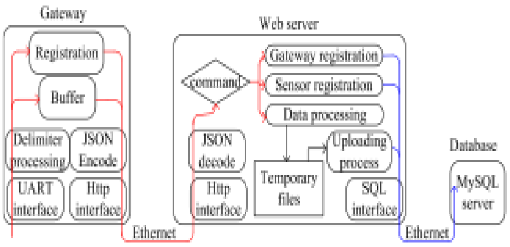


**Fig. 6**

The final object in this paper is to deliver all sensed data to the database on the Internet. The overall architecture is illustrated in figure 6 with a web server to act as the processing unit and interface with other entities. For fulfilling diverse requirements of different IoT applications, the sensor nodes in WSN just send the raw data to the gateway without performing any translation or interpreting. Another reason why the gateway does not directly communicate with the database is that the database may not locate at the public network i.e., with a public address. The data from the WSN are delivered through the UART interface at the gateway. After delimiter processing, the data from different sensor nodes are identified and then either buffered or forwarded to the registration subroutine according to the data type. The communication between the gateway and web server follows the positive acknowledgment-based mechanism, that is, the web server sends acknowledgment messages back to the gateway after receiving any requests. If the gateway has a timeout event because of not receiving the acknowledgment in time, it will retransmit the request for reliable communication. All the messages are formatted in a common representation in JSON. In the followings, we discuss the three major requests, including "gateway registration", "sensor registration", and "data uploading". After a gateway is powered, it sends the "gateway registration" request to the web server, which contains the gateway name and its location. The web server scans the database to check if that gateway has been registered or not. If it is a new one, the web server will assign a new and unique ID which is carried by the acknowledgment message back to the new gateway. At the same time, the web server will also create a new corresponding table in the database. The ID can be used to identify a unique gateway on the Internet. In case that the gateway sends a duplicate gateway registration request because of missing the acknowledgment message,

The web server just returns the ID corresponding to that gateway back. After a sensor node is synchronized with its parent, it sends a control packet containing the sensor information to the gateway. Upon receiving this packet, the gateway generates a "sensor registration" request to the web server, which contains the sensor node's WSN address, the gateway ID, the number of sensors, and the types of all attached sensors. Similar to the operation of "gateway registration", the web server needs to check if the sensor has been registered or not. For a new sensor, the web server will assign a unique sensor ID which is carried by the acknowledgment message back to the gateway. The gateway maintains a local table storing the mapping between sensor node's address and ID. At the web server side, it creates a new table for the new sensor in the database. The centralized management of sensor ID from the web server allows any user to uniquely identify all sensors even from different gateways or platforms.

### Optimal Sensor Self Localization:

In this section we present different non-linear optimization formulations that have been proposed in literature for range based localization. We then provide practical guidelines for solving these problems efficiently on an embedded system, which can include encoding additional problem information such as room topology through inequality constraints. The sensor self-localization problem can be naturally written down as an optimization problem with i) the estimated sensor locations as decision variable, ii) measured distances given as parameters of the problem, iii) the coordinate system conventions enforced with constraints, and iv) a sensible objective that is an error function between measured and estimated locations. The particular choice of the objective, as introduced next, determines the accuracy and tractability of the optimization problem.

## 7. Results and Discussion:

These algorithms are used to make decisions towards the supply-demand in power grids, to control dynamically the acquired data from the IoT devices also from the wireless sensor network nodes and take a appropriate decision to respond for proactive measures depending on the applications where we apply the algorithm and according the detailed study this give better performance when we use in the dynamic environment rather than the static environment. This algorithm is also used to gather information from the near by agents and by keeping this information it will be used to determine the delays in communication presence.

The application layer is used to monitor the performance, identity as well interdependencies of cross layers. The application layer is used in QoS analysis. IoT is used via Cloud Computing in the health monitoring platform, In some applications an IoT can be used in the application layer and decision making layer decides which customer which product and their bin size to be done and sent via IoT for further processing. In the 7 layers, it has to support the data management and maintain the decision making in order to avoid error free functionalities in the fully mechanized system. The same algorithms can be used for making decision from the data received from the data analytics via IoT. In few applications the data analytics, application layer have to make a decision which signal to be ON/OFF. Using the Application Layer and decision making concepts has been used to encrypt the data. A study has been done to analyze the work on delivery models and deployment models using the Cloud. In WSN without using IPs they have tried using VPNs for data collection or sharing of information. WSN and RFID enabled IoT analsis has been done. In IoT Time frequency analysis has been used to transmit the image signal and image processing is used by DWT and STFT algorithms to analyze the images and their quality. IoT is been used in MQTT, AMQP and CoAP and decides which to be used and the analysis saya that CoAP is better. Conventional WSN doesn’t work properly and SDWSN routing is operated in the controller and it establishes the distance info and computes the closest path to transmit data for each node and proceeds further. WSN in the physical layer and MAC layer using IPv6 for home automation. In this using numerical calculations related to the SNR and the channel capacity, battery life of IoT sensors has been increased.

According to the detailed survey, we have found that the decision making algorithms, Application layer, IoT in cloud domain collectively can be used to optimize the power consumption, effective data acuqistion and analysis can be done only in the dynamic environment. If we use the same for the predefined algorithms then the efficiency won’t satisfiable.

## 8. Conclusion:

In this paper, we are proposing a novel approach to optimize the distributed consensus algorithm in the decision making concept and application layer are been effectively in IoT based Wireless sensor networks (WSN). In this we are addressing 3 problems. First one is based on the distributed consensus algorithm we can optimize the decision in power grids to take decision depending on the supply and demand. Second one is application layer can be used to monitor, identify the interdependencies in the cross layers and QoS. Third one WSN can be used to gather the information of the sensor nodes and the same can be processed for further. The distributed consensus and application layer can be used optimistically to make decision in the different application. These algorithms are used to make decisions towards the supply-demand in power grids, to control dynamically the acquired data from the IoT devices also from the wireless sensor network nodes and take a appropriate decision to respond for proactive measures depending on the applications. According to the detailed survey, we have found that the decision making algorithms, Application layer, IoT in cloud domain collectively can be used to optimize the power consumption, effective data acuqistion and analysis can be done only in the dynamic environment. If we use the same for the predefined algorithms then the efficiency won’t satisfiable.

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