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Autonomous Data Centers ADC: using Agent Role Locking Theory (ARL)

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ABSTRACT

Modern society is defined as an Information society, because information is the main tool for this society, more than 70% of population in this society are working in information and data related jobs. Data is the raw facts of information, each single day more and more data is accumulated conducted by people, and even by machines that are connected to Data Centers (Cloud) , these data centers are holding a huge amount of data, defined as Big Data repositories. Data is the basic block to build information system to produce models about human behaviour and interests, as well as , models for machine's performance. Modern machines are oriented to be more autonomous and Smart. machines and devices, that connected to cloud which considered as the principle of Internet of Things (IoT). Currently, demand for data centers is rising, these centers give more competitive edge in customer services and better functionality, data centers may located in remote areas, that hard to be reached out , These data centers must be autonomous , continuously functioning and independent. This article presents Agent Role Locking Theory (ARL) to operate autonomous data centers without human intervention, first section we will talk about related work, second section will go through methodology to have autonomous data centers, third section ARL as smart agent oriented algorithm is applied and presented on real application readings , and finally we conclude this work

Key words: Smart, Autonomous, Data Center, Agent, Thread, Photovoltaic, Cloud, Edge Computing.

1.RELATED WORK

Internet of Things decentralization is one of the most significant characteristics of modern information society. Huge data is collected regarding human behaviour , interests , and healthcare , best example is Covid-19 related data sent daily for data centers data about people ., on the other hand, a huge amount of data is collected from machines, airplanes and vehicle sensors ..etc to keep a record of performance , *Edge computing*, shown in Figure 1 , is recording and evaluating a huge volumes of data sensor in locations where real-time conditions mean that data cannot be transferred to the cloud, is fuelling the creation of smaller computing units, which may be sited in the immediate location of machines.

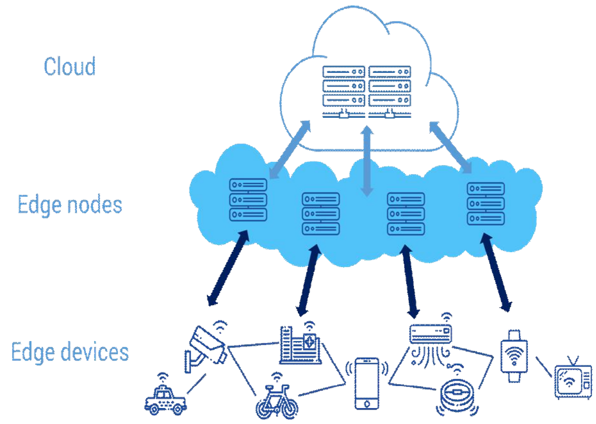

Figure 1:: Edge computing

Data from IoT is growing exponentially, this data comes from machine and smart devices censor is impressive and unsustainable under current architectural approaches. Many IoT deployments face challenges related to latency, network bandwidth, reliability and security; which cannot be addressed in cloud-only models [1].

The proposed solution to over come these problem is instead to fully dependant on cloud is using edge platform solutions which enables workloads to be processed at the IoT edge to enhance security, enable real-time decision-making and reduce IoT data storage and transport requirements.

Global distributed e-marketing companies start to use the Edge computing, calls for the need of establishing disturbed geographical data centers , these centers are data repositories that used for Internet of Things (IoT) . Disturbed geographical data centers are needed for monitoring and for supervising the connected devices and machines, and most important remote-controlling those devices that need real time execution.

Good example of Edge computing is self-driving cars (autonomous), the critical functions are always accommodated inside the vehicle itself, without relying on any form of cloud connection. As a result, we may see an increased trend towards mini data centers. The industry is already looking at solutions such as data center containers, which would be much easier to use in conjunction with autonomous concepts.

New tends of technology are pushing huge and well know enterprises to use data centers, theses centers are scattered around the world and distributed in remote and isolated geographical sites. An example of these enterprises are Google, Amazon, Microsoft, Apple, China Telecom, China Unicom , IBM…etc

Autonomous Data Center (ADC) is a center that operates without the constant supervision of its equipment, like storage, network, data security, in other words - is a data center that virtually runs itself; automatically adjusting server machine , networking and storage to adapt to the changing demands of the applications and services critical to the success of the business.

Figure 2 is defining the main components of ADC , the main factor of ADC is power independency , this center has the ability to manage the power generation and consumption for keeping the functionality of the ADC , that means continuous work without human intervention , especially as these centers may be in a remote and isolated areas

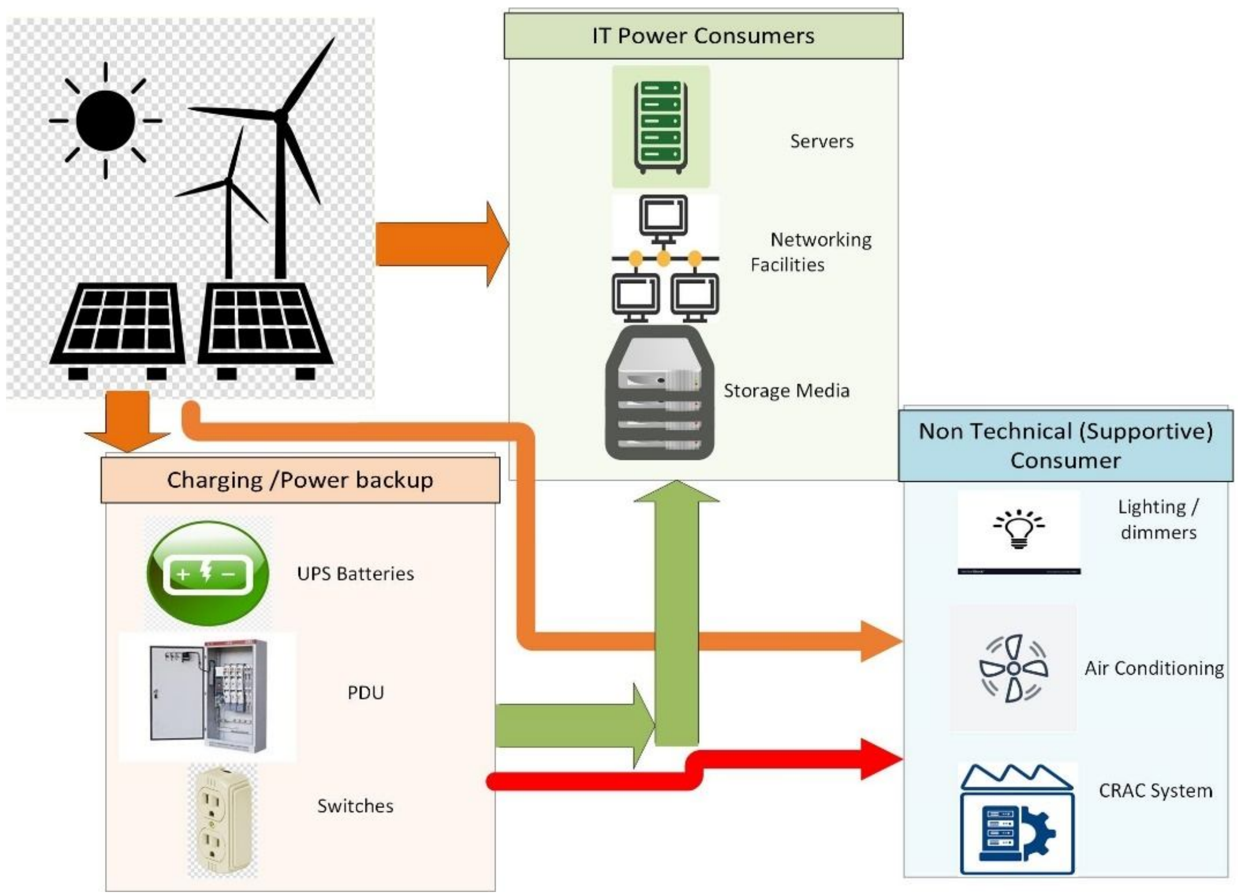

Figure 2: Autonomous Data Center power generation and consumption

2.DATA CENTER POWER EFFICIANCY

The main objective of ADC to have independent and autonomous continuously functioning data center , and more with smart functionality , like proactivity . that can predict some shortage or some fault could be happened and act before that power shortage and fault function will occurs , by taking design to over come that fault or power shortage , as to have a human personnel spending 24 hours / 7 days taking care of this center , and that's the reason why using smart agent system is most applicable approach [2]Researchers have defined two related definitions to check performance of power system of data centers:

1- Power usage effectiveness (PUE) is a metric used to determine the energy efficiency of a data center. PUE is determined by dividing the amount of power entering a data center by the power used to run the computer infrastructure within it. PUE is therefore expressed as a ratio, with overall efficiency improving as the quotient decreases toward PUE = (Total Facility Energy) / (IT Equipment Energy)
2- Total Power efficiency (TPE) is is a metric used to determine the energy efficiency of a data center. the reciprocal of PUE and is expressed as a percentage that improves as it approaches 100%.

TPE =(IT Equipment Power + non IT Equipment)/Total Facility Power x 100%. To manage power in ADC we need to determine the amount of power generated as input ,

normally , power generation in theses center will come from Solar Photo Voltaic PV or from Wind turbine , these are the main couple of resources of Renewable Energy RE, in addition to these resources there must be supportive battery bank . Time (t) period is an important factor in power suppling , because RE is normally varied by time.
Power Supplied = solar + wind + backup batteries

$$P_t=\sum_{t=0}^{\infty} s_t + w_t + |b_t|$$

From other side , it's very important to have full view of power consumption , there are three categories that must be considered. Technical is representing data related equipment that have the most priority to consume power for keeping ADC running., Secondly, Supportive equipment that represent all equipment give support for ADC to perform work, like Computer Room Air Conditioning (CRAC). Then the excessive power is directed into battery charging.

Consuming = Technical + Supportive + Charging

$$C_t=\begin{cases} \sum_{t=0}^{\infty} \Delta T_t + \Delta S_t + \Delta C_t & P_t \geq \alpha \\ \sum_{t=0}^{\infty} \Delta T_t + \Delta S_t & \\ \alpha > P_t \geq \beta & \\ \sum_{t=0}^{\infty} \Delta T_t & \\ \beta > P_t \geq z & \\ \text{Graceful Shutdown} & P_t < z \end{cases}$$

2.1 ADC Power Consuming Equipment's

In the digital revolution data centers are considered the main factor for managing huge data transferred from smart devices into the cloud. more over Edge computing is growing rapidly and it's now considered the backbone in modern technology. The main requirement s and principles in data centers are independence , autonomous , server virtualization, cost-effective storage, and increasingly powerful hardware, digitalization and models associated to these ADC must be smart to cope with variations and unstable conditions around .

Smart behaviour is defined as autonomous and proactive , ADC comes to pair automation concepts – such as those used in modern Industry and the Internet of Things (IoT) – with artificial intelligence in data centers. The task of analysing the enormous volumes of data generated by our ever-more complex systems and structures plays to the unique strengths of artificial intelligence.

These algorithms assume responsibility for entire processes, requiring humans to intervene only to make decisions in very extreme exceptional circumstances. Robotic process automation relies on machine learning and deep learning technology. We must now extend the thinking and methodologies that we currently apply to factory automation and digital twin technology to data centers.

We need define the constants $\alpha, \beta \text{ and } z$, table 1 and table 2 shows the average daily amount pf power consumed by technical and non technical equipment , [3] then accordingly we can set the value for each constant. But we should know that these constants are set according to average so it's not precise , so it sometimes goes up or comes down and that's why we need a history report of big data of consuming to determine what ate the values of these constants Technical equipment is running all together or non, because big data storage and transmitters or receivers are using various technical part,

Table 1: Power Consumption of Technical equipment Per Day

Number	Technical item	Power use	Kilo Watt Hour KW/H	Total running hour/ Day KW/H	Total Power Consumption KW/H
1.	Desktop Computer (Server)	100	0.1	24	2.4
2.	LCD/LED Display or TV Screen	30	0.03	24	0.72
3.	Wi-Fi Router	6	0.01	24	0.24
4.	Hard Disk Wrack	40	0.04	24	0.96
5.	Printer	40	.004	1	0.04
6.	Networking Equipment + Switches	30	0.02	24	0.48
7.	DVR and Cameras	50	0.05	24	1.2
Total					6.04

Table 2: Power Consumption of non-Technical equipment Per Day

Number	Non-Technical equipment	Power use	Kilo Watt /Hour KW/H	Total running hour/ Day KW/H	Total Power Consumption KW/H
1.	CFL Light Bulbs (inside)	56	0.05	8	0.4
2.	Incandescent Light Bulb (outside)	240	0.24	6	1.44
3.	Fans	75	0.07	12	0.24
4.	Air Conditioning	800	0.8	6	4.8
5.	Security Alarm System	30	0.02	24	0.48
6.	Batteries charging	600	0.6	5	3.0
Total					10.36

and each part of every part is fully dependant on the other related technical parts. So the technical equipment will run as package. But concerning non- technical equipment we can control each of which according to the need and fictional requirements for example lights when it's going dark , heating when getting cold and vice versa ..etc. Figure 3 shows the percentage power consumption between all ADC equipment we notice that the largest share is going for technical equipment and then for air conditioning (heating or cooling)

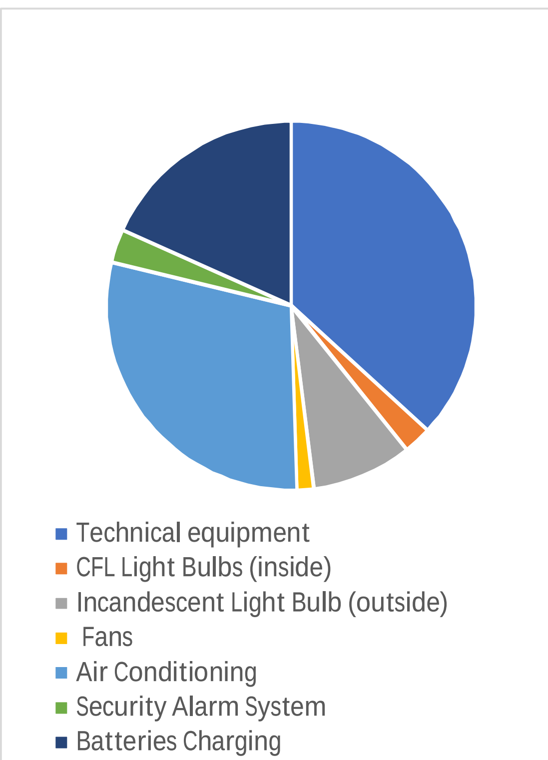

Figure 3: Percentage of power consumption in Data Cente

2.2 Power Production in Data Center

In this article we going to concentrate on real application, that represents an actual research case study which defines the data center is powered by solar system , ADC model is located in a way out of city and off-grid of Hebron District – Palestine more specifically in *Zeif* area , Figure 4 [4] depicts the Average Global Tilted Irradiation of Palestine, the irradiation is the main factor to generate power in solar system , it depends mostly on daily weather condition and region climate.

There are many related parameters affect irradiation and consequently power generation. Solar irradiance is the power per unit area (watt per square metre, W/m^2), received from the Sun in the form of electromagnetic radiation as reported in the wavelength range of the measuring instrument.[5] Irradiance on the Earth's surface additionally depends on the tilt of the measuring surface, the height of the sun above the horizon, and atmospheric conditions

As we notice from Figure 4. Not necessarily hot areas means more irradiation and consequently more power generation. A good example for that , we notice solar irradiation in mountainous Hebron-Palesine area is much higher than Tulkarem-Palestine which is a coastal region, even though it's much worm an even much hot compered to Hebron, we see it's has less solar irradiation and consequently it generates less power

The main atmospheric factors that affect power generation in PhotoVoltic PV energy are :

- Temperature : Sun brightness with more temperature produces more power best range of temperature is 25- 65 Celsius
- Shading : Clouds prevents immediate solar Impact of irradiation on PV cells
- Humidity : molecules of water H_2O in air will absorbs solar radiation reduce power

- Dust : in air or on surface of PV cells will prevent direct solar irradiation

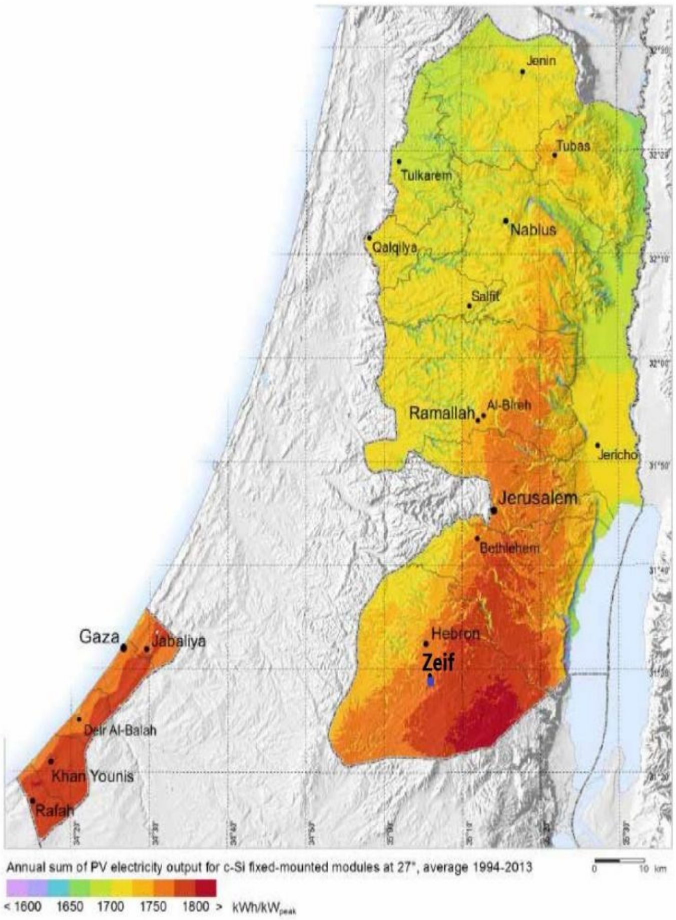

Figure 4 : Average Irradiation of some parts of Palestine

Retuning back to our AD, we must notice that the room temperature of data center must not exceeds 22 C and not less 14 C [6]

We notice that the most important sector of power consuming in Figure 3 is air conditioning or CRAC , to keep the room temperature most convenient 18- 22 Celsius

Figure 5 is about the maximum and minimum temperature in Palestine . It shows that in some months specifically December , January , February and part of March we need to *warm up* the data center room - *night time*- , specially at night that means , it will operate on battery bank power, the rest of the months we need to *cool down – light time*, the room needed to cool down in day time directly from PV with support of battery bank if needed. In the coming sections we will set the approximate values to the smart prototype model to see how much effectiveness we will have and at the same time store daily related data into data repository in form of data sets to make data training for final model.

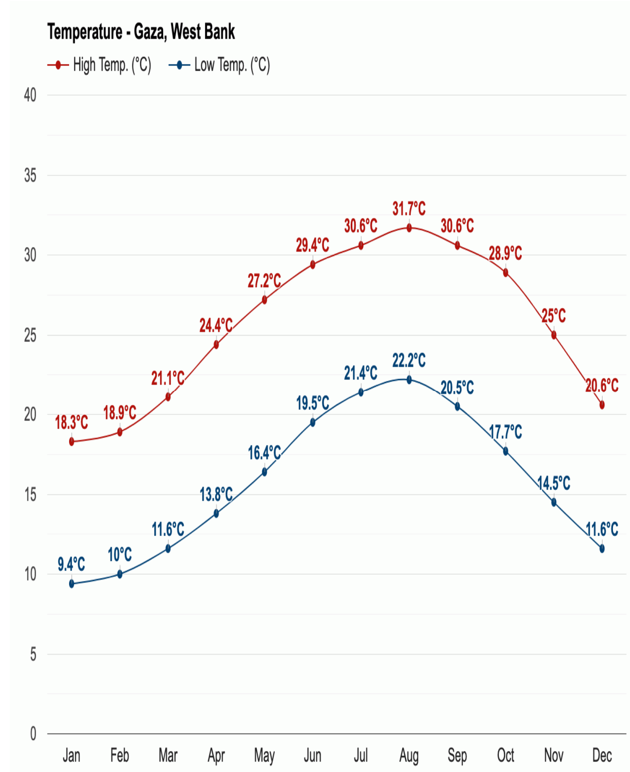

Figure 5: Average maximum and minimum temperature in Palestine

From the average estimations and depending on the equations given in the previous sections, we can determine the amount of the most appropriate variables to produce energy enough to run the ADC , Table 3 depicts the amount of power technical and nontechnical equipment . then calculate the PUE and the TPE for 1 m^2 cells , $1m^2$ ', and for $1m^3$, then determine which is satisfy total amount of TPE and PUE , we notice the amount of power generated is varies with large interval of difference , we notice February is the lease June is the most.

Figure 6 defines the curve of PUE and its minimum required value in *red line* [7] which has the value of 1 , and shows the curve of TPE and its minimum required value in *red line* , which has value of 100%, We notice from Figure 6 that $3m^2$ PV cells plats are satisfactory for the ADC , but we might have a little shortage in the months January and February to use entire TPE , we can over come this problem by stop running unnecessary non-technical equipment like lights and fans and air conditioning in the day time because the weather is close to 18 in these two months Figure 5 and manage power distribution as discussed later.

Table3 : TPE and PUE of PV cells of 1m^2 , 2m^{2}and 3m^2

	Power Production		Power Consumption							
month	average by by month	Average by a day	Technical	non-Technical	PUE 1m	TPE 2m	PUE 2m	TPE 2m	PUE 3m	TPE 3m
January	120	5.00	6.4	10.36	0.78125	29.8%	1.5625	59.7%	2.34375	89.5%
February	117	4.88	6.4	10.36	0.761719	29.1%	1.523438	58.2%	2.285156	87.3%
March	158	6.58	6.4	10.36	1.028646	39.3%	2.057292	78.6%	3.085938	117.8%
April	172	7.17	6.4	10.36	1.119792	42.8%	2.239583	85.5%	3.359375	128.3%
May	237	9.88	6.4	10.36	1.542969	58.9%	3.085938	117.8%	4.628906	176.8%
June	283	11.79	6.4	10.36	1.842448	70.4%	3.684896	140.7%	5.527344	211.1%
July	279	11.63	6.4	10.36	1.816406	69.4%	3.632813	138.7%	5.449219	208.1%
August	259	10.79	6.4	10.36	1.686198	64.4%	3.372396	128.8%	5.058594	193.2%
September	214	8.92	6.4	10.36	1.393229	53.2%	2.786458	106.4%	4.179688	159.6%
October	168	7.00	6.4	10.36	1.09375	41.8%	2.1875	83.5%	3.28125	125.3%
November	145	6.04	6.4	10.36	0.94401	36.0%	1.888021	72.1%	2.832031	108.1%
December	133	5.54	6.4	10.36	0.865885	33.1%	1.731771	66.1%	2.597656	99.2%

PUE : Power Usage Effectiveness
TPE : Total Power Efficiency

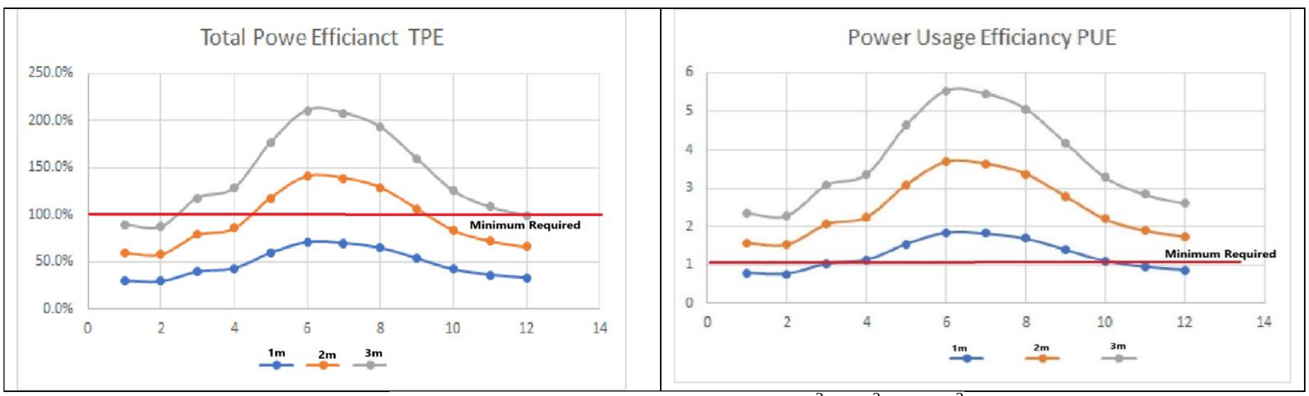

Figure 6: TPE and PUE of PV cells of 1m^2 , 2m^{2}and 3m^2

3. METHODOLOGY & ARL APPLICATION

the main aim of autonomous data center is to keep the power equals or above to the amount of power required for continuously running IT equipment in this center. IT equipment can be considered as the server of big data repository. As presented in previous sections we have define an estimation of the power needed to run technical and non technical equipment in ADC, so we can predict how much power we need to cover the power consumed by running these equipment.

We notice that we use the words *estimate* and *predict* for running this autonomous data center , because power production has many uncurtains variables that affects the power production process, on the other hand, power consumption has many unprecise variables that unstable and changing from time to time. We can determine the variables that affects the performance of power generation in renewable energy for our case as PhotoVoltiac solar system with the following variables:

1- The number of square meters of PV cells.
2- The amount of irradiation in the geographical area
3- Atmosphere conditions (Temperature t , Shading s , Humidity h , Dust d)

ADC is representing of smart entity. It has the ability to run autonomously, by sensing the input power and output power and then arranges the operations accordingly, and it has proactive abilities that take decision to operate or stop any non technical equipment in case it feels there is going to be shortage in power . On these conditions ADC need to sense the a rounding environment to determine the value of each components in the center and act accordingly , sensors like the following :

1- Battery charging - sensor
2- In-room temperature air conditioning - sensor

3- Lights sensor and moving - sensor
4- Incoming power- sensor

Figure 7 defines the functional structure model of ADC which can be used as both edge computing for the center itself and cloud computing for other remote data centers. This model is highly dependant on many variables , and more over these variables are inconsistent by time and dependent on a certain conditions, so every thing is changing and it's almost impossible to set an ultimate equation to join all the variables in a general equation to define power consumption and production.

We have mentioned before, this kind of system needs a particular applicable view rather than [11] theoretical hypothesis, we must point out that it's not useful to have data training and theoretical machine learning algorithms that not lead into real application. That means, in this proposed model , while we solve the main problem of autonomous data center by setting up constant and variables values intervals , we also work in parallel with data training to determine constrains of constants and values of variables affect ADC,. This accomplished by produce a fully functional model that works depending on estimations and predictions that we have initially set . then re-calibrate variables value into real training data set and keeps prototype model running and use the calibration values resulted by training variables as feedback in the result model . Finally run the final model after a whole year 12 months passed (365 days) and change the figures of variables with the new related values that affects the power producing and power consuming.

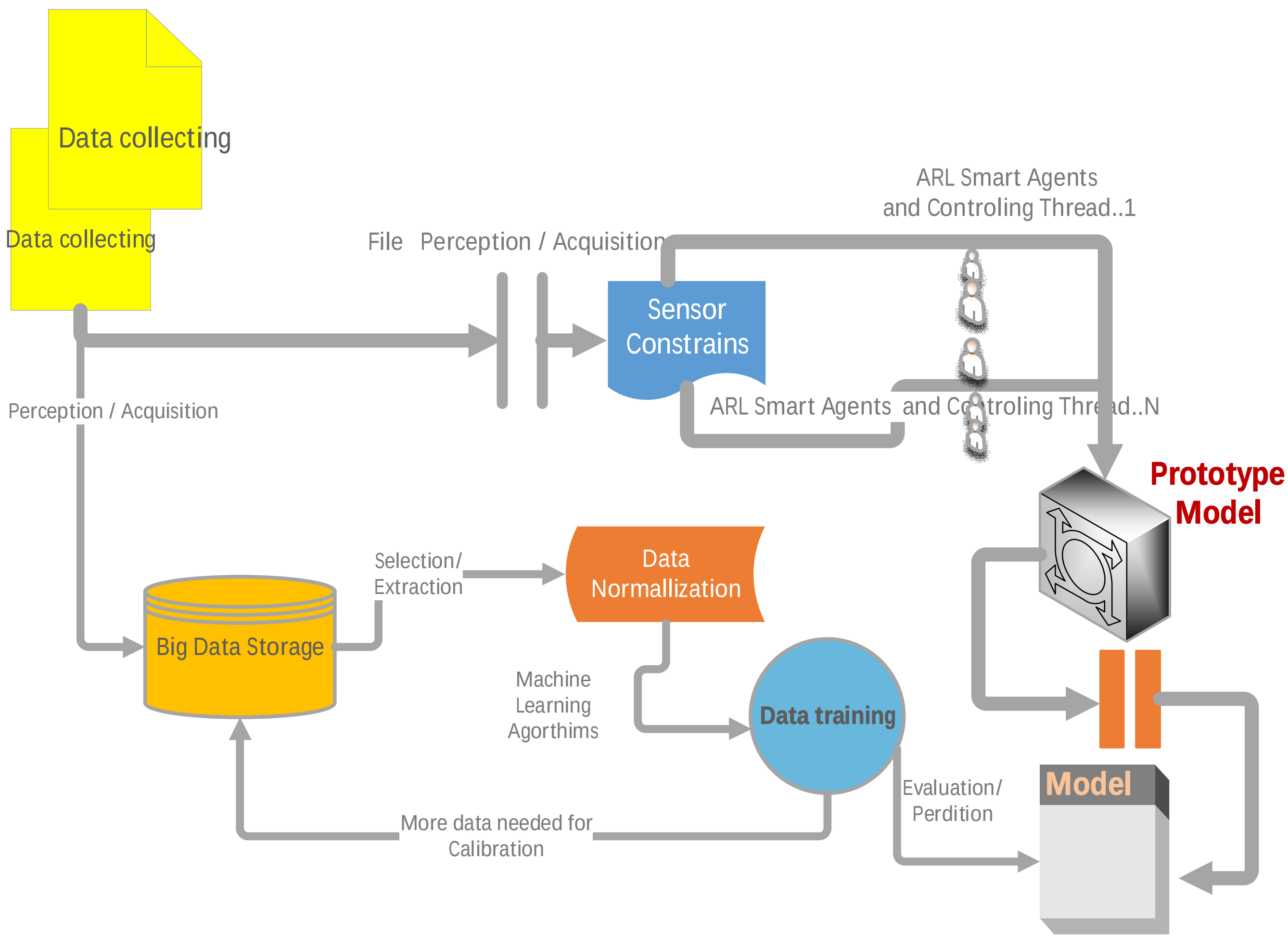

Figure 7: defines the functional structure model of Autonomous Data Center

Figure 7 is explaining the methodology for Appling the autonomous data center, it's divided into two parts: Prototype model and Final Model.

Prototype model is installed as part of autonomous data center in Figure 2 this prototype is installed and applied based on general initial predicted and average readings, theses readings is collected from sensors of related variables of main parts of ADC, the main purpose is to get the system to start functioning . this prototype uses estimated factors to determine the satisfactory autonomous functionality . Table 3 is defining the most important variables of power production using $1m^2$ of PV solar sells and check the output it shows with $1m^2$ is not even enough to run technical equipment as it is shown in Fig 6 but if we used $2m^2$, we see technical equipment will work with minimum capacity but non-technical will not fully guaranteed to work full load , finally with 3 m^2 we see all technical and nontechnical equipment will run properly but in December ,January ,February will face some shortage in power efficiency.

Final Model is an extension of protype model , it collects data from different signals transmitted from censors , store and normalize this data to be used in data training , and used as inputs for machine learning module , with purpose is to recalibrate sensors constrains into more accurate values taking in consideration the interdependent variables of power production and consumption.

This kind of application has very delicate characteristics. there are many unstable variables involved in the system, such as variables that affects power supplier and unstable amount of power consumption, and variables involved concerning atmosphere and geographical location of data centers . Basically everything is this system is changing and it's hard or almost impossible to set a specific classical algorithm to manage all theses some kind of arbitrary values . Many researchers in this field tried to write some algorithms to represent some solution for manipulating power system in data centers [8] [9], normally , but these algorithms haven't been applied in application, this kind of controlling system is defined as *real time systems* or "*just in time* "processing, after studding the proposed algorithms these algorithms uses classical one thread program *main ()* , the processing phase of this system is nested endless *while* and *for looping* to represent the circle of life of power management with sequence of *if statement* to change control .

As we mentioned , the environment of Autonomous Data Center is highly un predictable , so it cannot manage some faults might occurs while the execution is looping a way from this if statement loop section , more over what happened if two or three faults or unpredictable readings occurred at the same time . on this basis *monolithic* algorithm and executions will be not satisfactory and above that totally wrong approach with this continuously changing and unpredictable environment.

ARL [10][13[1]] is a theory for engineering and programming multi-agent systems, Agent in this context is a *thread* of multi-threading programming, agent are the controllers that can efficiently run this unpredictable environment. Normally smart agents have *preceptors as "sensors"* that continuously understand and analyse the a rounding environment, then it acts according its main objectives to serve the autonomous data center by keeping it running. For people who are unfamiliar with this kind programming , imagine that every agent is an employee that will sense and act according his/ her job description, if we have more than one agent then the system becomes multi agent systems that means more than one employee that arrange and work to get objective job done (*Goal*).

To apply ARL on this autonomous system we need to assign agents objectives , actually we can create agents as much as needed even with each single equipment, then we can instantiation agents to control every piece of hardware exist in the Data Center , but the most important agents that must be there are :

1- agent to insure the PUE is enough to power the technical equipment's ,
2- Agent to check if power is enough to run non-technical equipment
3- Agent to check out the outcome Kw/h produced by PV
4- Agent to check batteries charge

According to ARL each agent is a thread of execution, the preceptor of agent are sensors installed in the data center various equipment, these sensors send continuous signal and reading to the smart unit of sensor constraints to check and do something or stay idle. If one of the reading goes into a curtain reading this agent *thread* will *run ()* to execute the objective of this smart agent obligated to do.

Threads are the physical representation of agents , their role is to console and distribute the power in the smart data center so that the priority is for the following priority Technical equipment then to

According to system functionality we can define the following agents /threads with their sensors "

<u>PVp: generated power</u>

<u>bp :battery power</u>

<u>*mtep*: maximum power needed by technical equipment</u>

<u>*tACp* : power needed for Air Conditioning</u>

<u>*Chrgp* = minimum power that can charge battery banks</u>

```
Algorithm
// thread for technical
{
 If (PVp >= mtep )
A.PVt.run()
 Else
  If (bp >= mtep )
A.Bt.run ()     // thread of technical from battery
Else
A.down.run ()
}
```

[1] This article will not go through ARL , more elaboration about ARL can be found at [10][12][15]

```
// Thread for non -technical
//notice that for lights and dimmers work only at night
  and switch-ONN or
 // movement detect sensors
// the CRAC will work to keep temperature  18 – 22 C
 // thread for CRAC

          {
          If (temp >= 22 ) || (temp<= 18 )
         {
           If  (PVP >= tACp )
             A.PVac .run()
         Else
          If (BP > = tACP)
          A.Bac .run ()      // thread of air
// conditioning from battery
 Else
A.down.run()

// charging batteries
excess = PVp – ( mtep + tACp )
ok = Boolean Check_full ()
if (not ok ) &&  (excess >=Chrgp ) A.PVchrg . run()
Else
A.PVchrg . sleep()

}
```

// worming at winter night time or effective // cooling at summer at day light time.

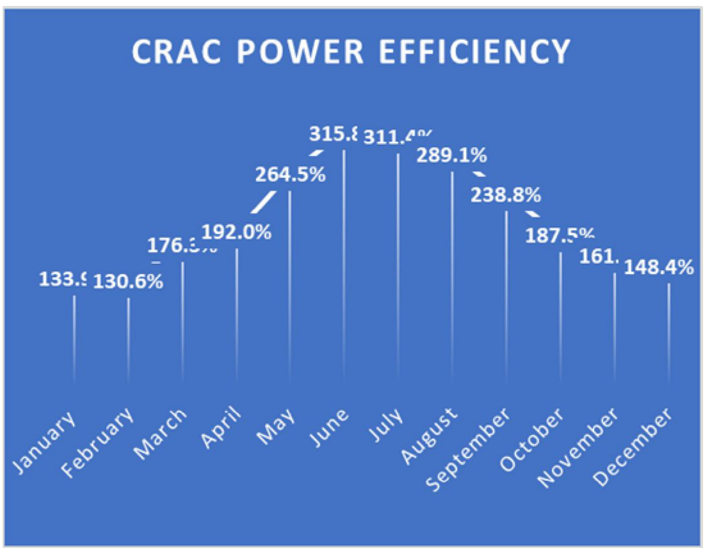

Figure 8: Excessive Power efficiency of day-light time for battery charging

Figure 8 shows the availability with good margin of power enough for TE and Airconditioning. This graph in Figure 8 comes from result founded according to the table 4 which presents the power efficiency of day -light time , the time of irradiation which is about 7 hours as average . so we notice that there is actually excessive energy can be used for barratry charging one of the most important component in ADC is the batteries , PV is supplying power though day light time.

At night time we need battery bank to give power for of the center during dark, for sake of research in this article we need to know some characteristic and specification related to batteries and converters and also transformers , characteristics that enable us to determine batteries needed to supply power all night long . Detailed discussions and debates are beyond this article scope.

First we need to know the relation between Watt (power) and Amper (electrical current) and Volt (voltage) , because working with batteries required to deal with these variables as it's Direct Current (DC) electricity.

The current I in amps (A) is equal to 1000 times the power P in kilowatts (kW), divided by the voltage V in volts (V):

$$I(A) = 1000 \times P(kW) / V(V)$$

Looking though batteries available, the ADC we installed High Energy Density Lithium Solar Batteries 12V 120Ah Solar Power System, battery bank has two batteries from this kind, battery specifications are shown in Table 5 , according to state of charge equation SOC(t) this battery bank needs no more that 6 hours to be full charged during day time.[13]

$$SOC(t) = SOC(t-1) + \int_0^t \frac{I}{C_{bat}} \cdot dt$$

Where :

Soc(t) : Battery state of charge at time t

SOC)T-1) : battery initial started of charge

I: Charge / Discharge current (A)

t : time (h)

Cbat : Battery capacity (AH0)

Air conditioning is part of CRAC that has one of the highest power consumption as shown in Figure 3 in the Autonomous Data Center , from Figure 5 we notice that it doesn't need much power for air conditioning to preserve the degree of 18- 22 Celsius, because the atmosphere degrees are not away much from these degrees. The degrees are moderate , highest and lowest in winter and in summer don't need the air-conditioning more that 5 hours a day some time day time and others at night of these 5 hours

Table 4: Power efficiency of day-light time used in Technical & Air conditioning

	Power Production			Power Consumption		
month	average by	average KW	average KW	Technical	CRAC KW	TPE 3m
month	by monthKW	by a day 1m	by a day 3m	KW	for 6 hours/day	TPE 3m
January	120	5.00	15	6.4	4.8	133.9%
February	117	4.88	14.625	6.4	4.8	130.6%
March	158	6.58	19.75	6.4	4.8	176.3%
April	172	7.17	21.5	6.4	4.8	192.0%
May	237	9.88	29.625	6.4	4.8	264.5%
June	283	11.79	35.375	6.4	4.8	315.8%
July	279	11.63	34.875	6.4	4.8	311.4%
August	259	10.79	32.375	6.4	4.8	289.1%
September	214	8.92	26.75	6.4	4.8	238.8%
October	168	7.00	21	6.4	4.8	187.5%
November	145	6.04	18.125	6.4	4.8	161.8%
December	133	5.54	16.625	6.4	4.8	148.4%

PUE : Power Usage Effictivness
TPE : Total Power Effeciancy
KW : Kilo Watt

For applying the system of ADC on 24 hour interval, we notice that batteries are the only source of power during night time , Table 6 displays the power efficiency for battery bank, taking in consideration [14] charging for 8 hours a day and suppling for 16 hours in average at night time . Figure 9 shows the amount of consumptions from batteries for CRAC and technical equipment in 12 month average.[16] And finally Figure 10 shows the average of power remaining in batteries in the morning after suppling technical and CRAC all night. If we look into the months December , January and February critical month for batteries specially in February , and needed to have more true data training to take actions if needed

Table 5 : Battery specifications used in ADC

Nominal voltage	12.8V
Nominal capacity	120Ah
Working current	50A - 0.25C
Type	Lifepo4
Pulse discharge current (less than 1 second)	200A - 1C
Discharge end-off voltage	8V/10V
Standard charging current	20A
Maximum charging current	50A
Operating temperature	Charge: 0 to 45 °C Discharge:-20 to 60°C
Storage temperature range	Less than 1 year:-20~25°C Less than 3 months:-20~40°C less than 7 days: -20~60°C

Table 6 : Checking batteries efficiency during 12 months

	Power Production day time			Power Consumption Day Light Time			Power Consumption Night Time	
year of 12 months	average by KW/h/ 1m by month	average KW/h/ 1m a day	average KW/h /3m a day	CRAC KW for 7 hours light/day time	Battery KW per Hour Charging	Battery per day KW/h	CRAC + TE night time KW/h	battery consumption at night time
January	120	5.00	15	4.7	10.3	72.1	11.5	95.83%
February	117	4.88	14.625	4.5	10.125	70.875	12	100.00%
March	158	6.58	19.75	5.1	14.65	102.55	11	91.67%
April	172	7.17	21.5	5.3	16.2	113.4	10.5	87.50%
May	237	9.88	29.625	6.2	23.425	163.975	10	83.33%
June	283	11.79	35.375	6.9	28.475	199.325	8	66.67%
July	279	11.63	34.875	7.4	27.475	192.325	7	58.33%
August	259	10.79	32.375	7.6	24.775	173.425	6	50.00%
September	214	8.92	26.75	6.5	20.25	141.75	7	58.33%
October	168	7.00	21	5.8	15.2	106.4	8	66.67%
November	145	6.04	18.125	5.1	13.025	91.175	9	75.00%
December	133	5.54	16.625	4.8	11.825	82.775	10	83.33%

PUE : Power Usage Effectiveness
TPE : Total Power Efficiency
TE: Technical Equipment
KW/h: Kilo watt /Hour

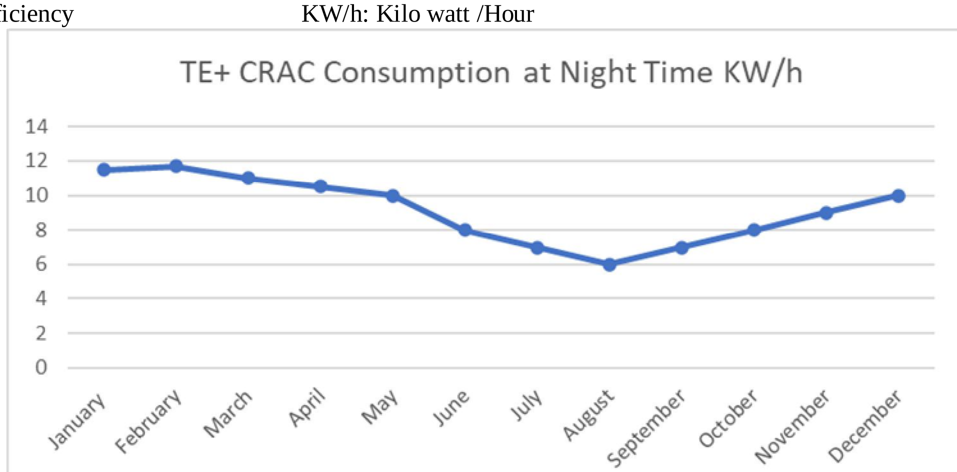

Figure 9: Power consumptions from battery during night time

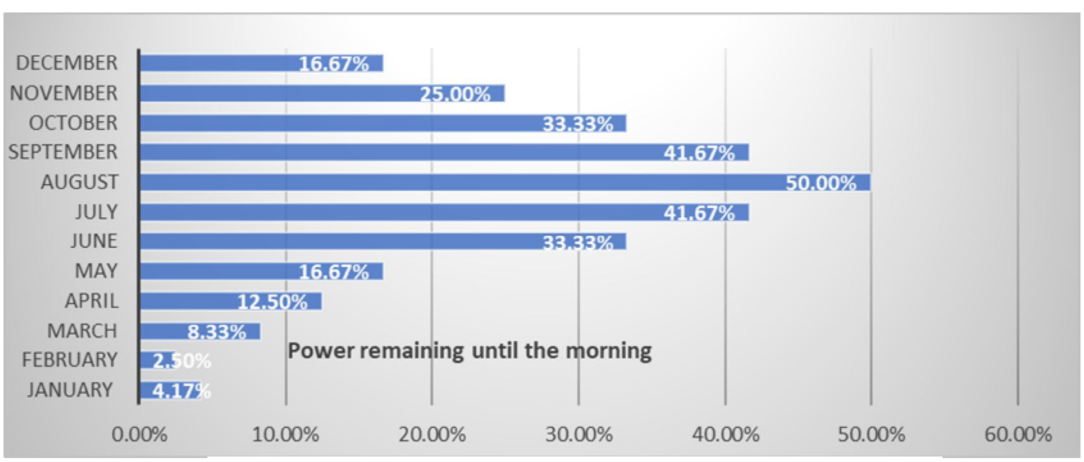

Figure 10: Average Power remaining in batteries for 12 months morning

4.CONCLUSION AND REMARKS

Smart is the keyword of modern technology, Smart Agent Orientation is embedding smart programable entities in modern devices and machines, this article is much concerns with smart building which is called Data Centers . we need to have a data center smart enough to be Autonomous and Proactive. The idea comes from the need to have data centers as part of Edge Computing, and these centers are spread in remote or isolated areas , that require to run and operate independently without human intervention.

ARL [15] is a theory to control smart software systems and robotics, agent in ARL is a thread that can be in run or hold according to system requirement and functionality in certain condition , so smart agents each has his own independent run time work together to run the Autonomous Data Center .this kind of systems that has many parameters and variables and non of them is static and is changing according to wide margin of condition , this system cannot be manage by monolithic programming operator , multi threading will be represent the actual real time processing system. Because that every thing is changing by time we divided the general model into two entity firstly , prototype which responsible to run the system according to estimation and assumption of sensors constrains , and second the final model which is responsible to do recalibrations of sensor constrains according to training and machine learning . this research is forwarded to researches who wants to work with field of big data and data training , and also forwarded to practitioners who would like a roadmap of how to build Autonomous Data Center

REFERENCES

1. Dennis Grewe, Mayutan Arumaithurai Ioannis Psaras , Dirk Kutscher **Information Centric Mobile Edge Computing for Connected Vehicle Environments: Challenges and Research Directions**, *MECOMM '17: Proceedings of the Workshop on Mobile Edge Communications* August 2017 https://doi.org/10.1145/3098208.3098210
2. Juneidi S.j., **Machines fault detection and tolerance using big data management***}, International Journal of Engineering Research and Technology*},, 2019,volume 12, number 1739-1750}.
3. Muhammad Akbar Rivai , Gunaawan Wang, **Cloud Computing Platform Services in the University Libraries for Digital Repository International Journal of Advanced Trends in Computer Science and Engineering** Vol 9 No.1 January 2020 https://doi.org/10.30534/ijatcse/2020/43912020
4. Palestinian Environmental NGOs Network Friends of Earth Palestine Dr. Ayman Rabi ,Dr. Isam Ghanem **Pre *Master Plan Solar Energy Production in Palestine*** *December 2016*
5. Stickler, Greg. "**Educational Brief - Solar Radiation and the Earth System"**. *National Aeronautics and Space Administration. Archived* from the original on 25 April 2016. Retrieved 5 May 2016.
6. B. Schaeppi, T. Bogner, A. Schloesser, L. Stobbe and M. D. de Asuncao, **Metrics for energy efficiency assessment in data centers and server rooms,**" 2012 *Electronics Goes Green* 2012+, Berlin, 2012, pp. 1-6.
7. **Weather Atlas . com Palestine , West Bank and Gaza**
8. Taheri, S., Goudarzi, M. & Yoshie, O. **Learning-based power prediction for geo-distributed Data Centers**: **weather parameter analysis**. J Big Data 7, 8 (2020). *https://doi.org/10.1186/s40537-020-0284-2*
9. L. Lv et al., "**Communication-Aware Container Placement and Reassignment in Large-Scale Internet Data Centers,**" in *IEEE Journal on Selected Areas in Communications, vol.* 37, no. 3, pp. 540-555, March 2019, doi: 10.1109/JSAC.2019.2895473.
10. Salaheddin J. Juneidi, **From Engineering to Programming: Smart Multi-Agent Application Using ARL,** *International Journal of Advanced Science and Technology* Vol. 29, No. 5, (2020), pp. 2700 – 2716
11. W N Hussein L M Kamarudin H N.Hussain M R Hamzah; K J Jadaa, **Technology Elements that Influence the Implementation Success for Big Data Analytics and IoT- Oriented Transportation System**, International Journal of Advanced Trends in Computer Science and Engineering (IJATCSE) (Vol.8, No. 5) 2019 https://doi.org/10.30534/ijatcse/2019/74852019
12. Salaheddine J. Juneidi, **New Computing Paradigm: Agent Orientated Engineering and Programming** , *International Review on Computers and Software (e-Journal)(IRECOS*) Vol 9, No 6
13. Fattah, A., & Khan, A. G. (2018). **Optimum charging scheme of Electric Vehicle (EV) battery.** *AIUB Journal of Science and Engineering (AJSE)*, 17(3), 103 - 109. Retrieved fromhttp://ajse.aiub.edu/index.php/ajse/article/view/15
14. Romli, Muhammad Izuan Fahmi (2018) **Solar energy management system with supercapacitors for rural application**. *PhD thesis, University of Nottingham*
15. Juneidi, S. J. and Vouros, G**., Engineering an Elearning Application using the ARL Theory for Agent Oriented Software Engineering**. In 2005 AAAI Fall Symposium, Arlington, Virginia, USA. MIT press.
16. Pooja Singh, Nasib Singh GillA, **Secure and Power-Aware Protocol for Wireless Ad Hoc Networks IJATCSE** Volume 8, No.1, January-February 2019 https://doi.org/10.30534/ijatcse/2019/07812019