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Optimal offloading in Clouds by NSGA II

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ABSTRACT

Mobile systems have limited resources such as battery life, network bandwidth, storage capacity, and CPU performance. These restrictions may be reduced by the extra-time computing: a heavy calculations and get results from server to server. Barry out a way to strengthen the capabilities of the transmission system, mobile computing is rich in computers. The main issue in this paper to obtain an optimal percent no load to achieve optimal energy consumption. In this paper, NSGA II optimization algorithm to optimize the parameters simultaneously, without time and energy is spent. The parameters of the proposed algorithms are designed in a way that would have been converging to the optimal. According to NSGA II algorithm in Matlab software simulation output results of the ranking member on several fronts, the optimal percentage of idle energy consumption at the client side, bandwidth and the average duration of a cycle, the different generations compared with each other and with other papers that show the performance improvement of the proposed method in this project.

Keywords: *Cloud Computing, Offload, Genetic Algorithm, NSGA II.*

1. INTRODUCTION

Advances in computer technology using desktop computers and mainframes in a wide range of embedded mobile applications, including surveillance, environmental sensing, navigation, GPS, mobile, autonomous robots, etc. expanded. Many of these applications run on systems with limited resources. For example, mobile phones battery powered.

Environmental sensors, small physical size, processor, and the storage are low. Many applications of wireless networks and wired networks are less than the bandwidth they need. Meanwhile, the systems are running complex applications such as video processing on mobile phones and the detected objects in a mobile robot. The gap between the demand for and availability of complex programs with limited resources is increasing.

Offload a way to strengthen the capabilities of the transmission system; mobile computing is rich in computers (eg servers)[1].

The traditional server-client architecture is different, where the customer has an account on the server transmissions. Offload transfer model calculations are also used in multi-processor systems and grid computing, where it is possible to balance the load transfer process, it is different[2].

The key difference is that in Offload computing, applications transmitted to servers outside of the user's computing environment Fu, for computing the transition from one computer to another network, typically occurs in the same computing environment.

The terms "Internet Explorer" and "alternative measures" is used to describe Offload calculations. In this paper we use the terms interchangeably above. Before 2000, researchers have focused mainly on making practical Offload. This is primarily a result of the limitations of wireless networks, including bandwidth is low. Earlier in 2000, according to the development of algorithms to decide Offload example is the decision about whether or not Offload the benefit of users is dynamic. Improvements in virtualization, cloud computing bandwidth and network infrastructure, have been directed towards the Offload. These developments, Offload computing has become a useful way. This article reviews developments Offload mobile computing systems in the last 15 years, and directions for future research identifies deals. Offload can save energy and improve the performance of mobile systems. If so, this is usually many parameters such as network bandwidth and the amount of data exchanged over the network are going to depend. Many algorithms for Offload decisions to improve performance or energy savings provided. Usually decisions by analyzing parameters such as bandwidth, server speed, memory availability, server load, and where the amount of data exchanged between the server and mobile systems are applied. Offload need access to a computer through a network rich for a short time, it is wired or wireless. The servers may be used to provide services Offload, so that

different applications and their data can be protected individually. Isolation and educated conservation incentives for research, development of infrastructure, for Offload at different levels work. Offload may be done in the levels of procedures, functions, applications, and virtual machines[3][4].
The elastic cloud resources and Offload are multiple servers; this is a link to offload calculations. Infrastructure and solutions to improve offload provided those with various issues such as user transparency, privacy, security, mobility, etc. are concerned.
All the infrastructure and solutions to the various problems associated with Offload notes. Current techniques used to make decisions Offload include the Offload (improve performance or energy efficiency), when the decision is taken to Offload (static or dynamic), what kind of systems are co Offload (Laptops, PDAs, robots, sensors), a variety of applications (multimedia, games, calculators, text editors, predictive) for Offload infrastructure (network and cloud computing)[5][6].

2. CLOUD COMPUTING

A model for delivering information technology services in which resources are retrieved from the internet through web-based tools and applications, rather than a direct connection to a server. Data and software packages are stored in servers. However, cloud computing structure allows access to information as long as an electronic device has access to the web. This type of system allows employees to work remotely.
As a metaphor for the Internet, "the cloud" is a familiar cliché, but when combined with "computing," the meaning gets bigger and fuzzier. Some analysts and vendors define cloud computing narrowly as an updated version of utility computing: basically virtual servers available over the Internet. Others go very broad, arguing anything you consume outside the firewall is "in the cloud," including conventional outsourcing[7].
Cloud computing comes into focus only when you think about what IT always needs: a way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new personnel, or licensing new software. Cloud computing encompasses any subscription-based or pay-per-use service that, in real time over the Internet, extends its existing capabilities.
Cloud computing has started to obtain mass appeal in corporate data centers as it enables the data center to operate like the Internet through the process of enabling computing resources to be accessed and shared as virtual resources in a secure and scalable manner[8].

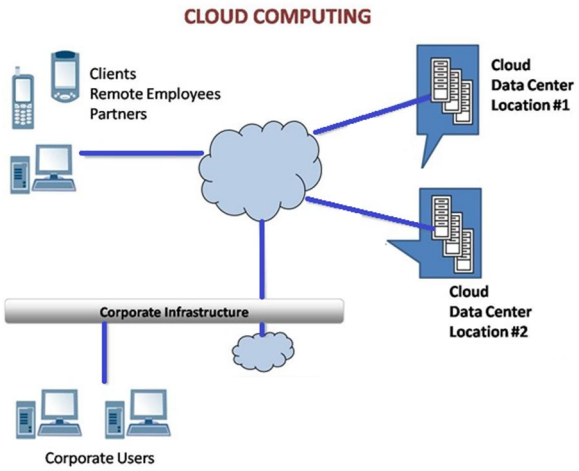

Fig. 1. Cloud Computing

For a small and medium size business (SMB), the benefits of cloud computing is currently driving adoption. In the SMB sector there is often a lack of time and financial resources to purchase deploy and maintain an infrastructure (e.g. the software, server and storage)[9].
In cloud computing, small businesses can access these resources and expand or shrink services as business needs change. The common pay-as-you-go subscription model is designed to let SMBs easily add or remove services and you typically will only pay for what you do use.

3. OFFLOADING

Mobile systems with limited resources such as battery life, network bandwidth, storage capacity and CPU performance. These restrictions may be reduced by the extra-time computing: a heavy calculations and get results from server to server. Barry out a way to strengthen the capabilities of the transmission system, mobile computing is rich in computers (eg servers). Before 2000, researchers have focused mainly on making practical time out. This is primarily a result of the limitations of wireless networks, including bandwidth is low. Earlier in 2000, according to the development of extra-time algorithm to decide whether it is for example in deciding whether or not extra-time to win the dynamic users. Improvements in virtualization, cloud computing bandwidth and network infrastructure, the extra time has paid off. These developments, outsourcing has become a useful way of computing time. Extra time may improve performance and energy saving on mobile systems can be. However, this usually many parameters such as network bandwidth and the amount of data to be exchanged over the network[10][11].

The basic idea behind cloud computing, mobile, outsourcing tasks to the cloud once the processing is done in the cloud, and then the results are transferred to the mobile device. This can lower energy consumption in mobile devices. Cloud can be accessed using a mobile network or WLAN hotspots. Alternatively WLAN networks are available. This can provide significant advantages in terms of cost and energy. Scenario pans out to a mobile user are shown in the following figure.

3.1 Tasks in Cloud Computing

Mobile cloud computing three types of tasks can be identified: 1) those actions that are processed locally on a mobile device. 2) Those actions that are processed in the cloud. Those operations that are processed in the cloud or mobile phone.

3.2 Offloading Methods

The main operation in mobile cloud will work extra time from a mobile device with limited resources, the cloud occurs. Due to issues such as physical distance, isolation and heterogeneity of mobile devices and the cloud, key systems, with a variety of different research methods is discussed.
In this section we will discuss three methods of data output time.

3.2.1 Client-Server

In this way, communication between servers and mobile devices via protocols such as RPC, Remote Procedure Calls and the socket is performed. RMI Remote Method Invocation and support for the Application Programming Interface. Extra time through this method means that applications must already be installed on the server. So mobile it can move according to the nature of the users' ability limit. Because the user may be in a range that neighboring devices can not offer services that they need[12]. Two examples are the systems of communication servers - customer service pre-installed for extra cargo via RPC protocol they use. Applications to connect to RPC servers Spectra local and remote use. When a client device needs to offload application server that contains information about Spectra with Spectra servers such as Web servers and load CPU etc. consults. These servers contain programs are already installed and act as servers. Spectra at run time according to the available resources, which decides whether or not to take the extra time[13][14].

3.2.2 Virtualization

Due to the benefits of virtualization technology, today most of these techniques to improve data center efficiency and increase their customers' use.
This technology provides an environment where virtual and physical machines with all kinds of data and puts it in a logical file.
Due to this feature, the machine can be moved from one place to another, the transfer function, is called migration. Such environments, data centers that are widely used these techniques to highly dynamic load and the volume of calls is changing. As you can see in the figure, this technique can be running virtual machines between physical resources can be moved. In other words, a virtual machine with all its existing programs (which are running), can migrate from one source to another, without being hampered by applications running on the user understand the Immigration. Overall migration techniques for purposes such as balancing and load sharing, tolerance against errors, energy management, reducing response time (improved accessibility) and maintenance of servers is used[15][16].
VM migration to transfer images from a memory Virtual Machine) source server to the destination server refers to a non-stop run. Such live transmission of the VM's memory pages that are already copy. Therefore provide an integrated picture. This approach ensures that you do not need to change the code when the program will time out. A live migration of virtual machines makes sure, but so much time and is too heavy for mobile devices.
In this section, a method is proposed using the concept of a cloudlet. Cloudlet similar to the design of a data center is perfect for small spaces and can be connected via the Internet to a larger cloud. Cloudlet internal mode is similar to a collection of multi-core computers with gigabytes of memory and high-bandwidth wireless connection. So the mobile device in the physical state of the source cloudlet cloudlet close and all the calculations are carried out. Mobile devices with a low latency wireless connection can be connected to the cloudlet. Tnyjh can be intractable in real time. If the user moves away from the cloudlet mobile devices can be connected to the cloud and in the worst case operating offline. Cloudlet detox center will be widely distributed and for the management and control of low power and Internet connection is required for installation. And can be a small commercial businesses such as coffee shops or dentist will use. Cloudlet only contains information that is accessible anywhere so it was not a disaster. Investigation showed that the restriction to simplify the reduction and management software.

The solution uses temporary cloudlet infrastructure using the vm hardware technology.
The essence of personalization prior to use and clean up before and after each use to support cloudlet infrastructure. VM-based approach to the transition process is more stable.

3.2.3 Mobile Agents

One advantage of this method is that it is dynamic. The method of communication server - client API that supports and stable, they need applications already installed on your system, and non ¬ operation in this connection are not supported. Due to the nature of the motion of mobile devices is a weakness in addition to continuing communication between server and client network congestion can cause. In this method, as shown in Fig. 1 Approach uses Mobile code for partitioning and distributing tasks. Well scheduler is introduced to estimate the cost. Methods for assessing the cost of the replacement server is faster than the standard method used to conduct surveys to ¬. Using this framework mobile device can replace one or more external devices to time. Tests indicate that a program running on one or more machines to virtual method has an enormous effect on performance.

3.3 Offloading Performance

Bandwidth: Bandwidth requirements depend on the type of service that is used directly. Common services such as email bandwidth restrictions do not show much concern. In contrast, some less common services, such as a heavy demand on an Internet connection to create virtual desktops. Especially when faced with a request high resolution images or multimedia content. Some tasks are highly volatile. Cloud storage services (either direct file sharing services like Drop Box or complicated cases may be too low or too high amounts of bandwidth allocated to them. Word and Excel documents usually have a low volume[16]. Instead images videos are very large and bulky. Upload the case of a large file on a server, cloud saving enough to block all Internet communications company users sharing the bandwidth is use of Delay of important considerations such as delay, bandwidth aside the will. Some applications, such as email programs are fully protected against network delays. This does not mean that lower latency is better. Desktop email clients and web applications in a way, but most are designed to be compatible in a certain amount of delay tolerant. The other programs are not. The delay is certainly the number one enemy of VoIP. Small delays as much as several tens of milliseconds is enough to make the sound quality is affected. Voice recognition is almost impossible Mylysanyhay hundreds of delays and a delay of typically 150 Mylysanyhay criteria for recognizing the possibility or impossibility of voice calls is considered [17].

Operating costs: the use of primary sources that are used by a particular user or application, of course, refers to the dynamic demand.
Due to the flexibility of cloud resources such as servers, software, energy and utilities, including UPS and battery system can be added and removed dynamically from the resource repository.
The total cost of ownership (TCO): is the total cost of ownership for IT infrastructure costs related to the ownership and management in cloud computing, TCO costs associated with servers, software costs, network costs, support and maintenance of electrical facilities the views.
The total time of the migration process: the period of the migration process starts from the state, and information on both machines (source and destination) is said to be fully synchronized. Reduce the transmission data size, data compression before transmitting such ways that will reduce this time.
The volume of submissions: As is known, the amount of data transferred between the server and the mobile device is exchanged[18].
Save Energy: Energy is the main limitation for mobile systems. Survey of 7000 users across 15 countries found that "75% of respondents said the most important features that extend battery life they want" less smartphone for only voice communications are used, instead, for access and watch videos, games, surfing the Internet, and many other purposes are used. As a result, these systems are likely to use more energy and battery life will be shortened. Although battery technology has gradually progressed, with the rapid growth of energy consumption in mobile systems, yet is able to keep. Offload may be transferred to a server of computational power, battery life increase[19][20].
RTT: telecommunications, round-trip delay (RTD) or round-trip time (RTT) time when a signal is sent along with the amount of time the signal is received. So the delay time includes the time between two points of a signal are.

4. NSGA II ALGORITHM

Srynybas and Deb 1995 NSGA optimization method for solving multi-objective optimization problems were introduced. Highlights of the optimization procedure are as follows:

- Answer the answer that no one, certainly better than not having more points. The answer according to the answer of which there are many, are ranked and sorted.
- Competence (fitness) to answer based on its rating and not overcome other answers, is assigned.

- To answer the fitness sharing method is used to adjust the distribution of answers in an appropriate manner and responses are unevenly search space to be played.
- Due to the relatively high sensitivity of the NSGA (Non-dominated Sorting GA) algorithm performance, and quality solutions to common parameters fitness and other parameters, the second version of the algorithm NSGA, called NSGA-II by Deb et al (2000) was introduced, the main features of this algorithm are:
- Define density as a feature space for alternative ways, such as fitness sharing.
- Use two-tournament selection operator - Dewey
- Storage and archive solutions obtained in the previous steps of the algorithm (elitism) [12].

The NSGA-II algorithm, the solutions of each generation, some of them using tournament selection two - Dewey elected. In method two - Dewey, the answer will be randomly chosen from the crowd and then the two solutions, a comparison is made, and each of which is better is ultimately selected. Selection criteria of the algorithm NSGA-II in the first grade and second grade answer from a condensation of the answer. Answer whatever rank is smaller and has far greater density, more desirable.

Repeat the operation with two choices - Dewey on the population of each generation, the generation of a set of crossover and mutation are selected to attend. On the part of the chosen people, the act of crossing and the rest of the action take place, populated by mutants and mutant offspring of survivors will develop. Furthermore, the population is merged with the main population. Members of the newly formed initially ranked according to ascending ordered. Members of the population who are of the same rank, in terms of density and distance are sorted in descending order**Error! Reference source not found.** [22]. Members are primarily based on population rank, and secondly in terms of distance sort condensation. Equal to the original population number, members of the list are selected and arranged the rest of the population are discarded. Selected members of the population that make up the next generation. In this part of the cycle, to realize the termination conditions, is repeated.

Answers frustrated recessive obtained from solving multi-objective optimization, often known as the Pareto front. None of the Pareto Front solutions have priority over the other depending on the circumstances; can be considered either as an optimal decision.

Multi-objective Optimization Problems that are capable of complex equations with multiple variables and different objective functions are to optimize. For example, in Figure 8, a multi-objective problem with two variables x1 and x2 is set to forms is created. Answer set, Y is the set of objective functions f1 and f2 space consists of two shaped. Points or optimal response in such a case the curve is drawn from the point of f1 and f2. This set of points, a set of Pareto optimal points to say**Error! Reference source not found.**.

The NSGA-II algorithm:

1. P0 population size N is randomly generated. T counters are used to distinguish between generations. This step is t = 0.
2. Reproduction and mutation operators by imposing a child population Q0 of size N are generated.
3. Population Rt of size 2N of the community will create Qt and Pt.
4. Using sorting method to overcome all members of the fronts F1, F2, ..., Fn are fronts for members of all levels of crowding distance is calculated.
5. Parent population Pt +1 is implemented as follows: If | P_ (t +1) | + | F_i |> N, Fi members who have more crowding distance are added to Pt +1 Pt +1 to N is the population size.
6. After the formation of Pt +1, using a chosen race, a comparison is carried out between members of any race. A member rank higher (lower) is to be chosen. When the ranking members of the same tournament, which is part of the greater crowding distance is selected. The reproduction and mutation operators to generate offspring Qt +1 of size N is used.

7- t = t +1 and go to Step 3.

4.1 Design Of chromosomes

pop (i). Position = unifrnd (VarMin, VarMax, [1 nvar]);

VarMin: zero minimum.
VarMax: Maximum amount equal to one.
Nvar: thirteen times the number of variables.
pop (i). Position: random value between zero and one.

X1	X2	. . .	X12	X13
0.9572	0.2785	. . .	0.8003	0.4854

Unifrnd performance function in Matlab software and file NSGA II is given by the 13 random numbers between zero and one produces and puts them in the variables X1 to X13.

For example, a variable that represents the value of x2 is Offload is much closer to zero percent Offload the low or even zero, and no matter how much of a close up Offload the percentage is even the value of a. This technique is in fact expresses the values that optimized phase has been documented in many articles**Error! Reference source not found.**.

4.2 Objective functions

The objective NSGA-II procedure in accordance with the following relationships are considered.

f (1) = sum (x (1) / ((x (2) * x (3)) + (1-x (2) * x (4))));
f (1) is equal to Th offload.
f (2) = sum (x (5) + x (6) + x (7) + sin (x (8)));
f (2) is equal to R offload.
f (3) = sum (x (2) * x (9) + (1-x (2)) * x (10) + x (11));
f (3) is equal to the energy equation.

Define the parameters required to perform three main functions used to optimize the project is as follows:
x(1) The number of bytes transferred , x(2) or a random value between zero and one percent, x(3) the average duration of a complete cycle - Old , x(4) the average duration of a complete cycle - new, x(5) Find the time required for local processing , x (6) the time required to send requests and receive replies, x(7) the time required for server-side computing , x(8) time delay, x(9) energy client, x(10) Energy Server , x (11) the total energy, x(12) client throughput, x(13) server throughput.

4. SIMULATION AND RESULTS

According to the NSGA II algorithm is simulated in Matlab software, results will be presented as it follows:

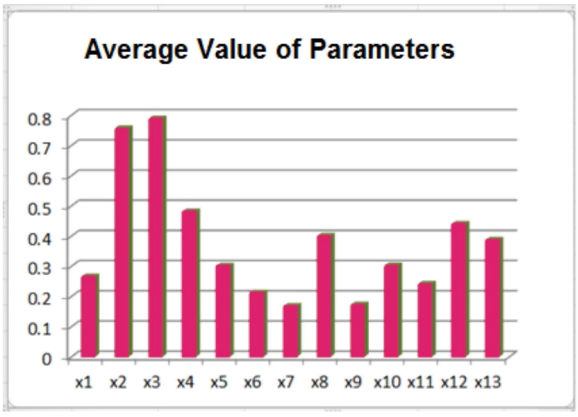

Fig. 2 . Average value of parameters

The horizontal axis represents each of the parameters x1 to x13 and the vertical axis against the mean values of each parameter for the 50 members of the population.
x (1) The number of bytes transmitted x (2) a random value between zero and one, or the percentage Offload x (3) The average time to complete a cycle - the old x (4) The average time to complete a cycle - the new x (5) the time required Find a local process x (6) the time required to send requests and receive responses x (7) the time required for server-side computing x (8) delay time x (9) client-energy x (10) energy server x (11) the total energy of x (12) client throughput x (13) server throughput[26].

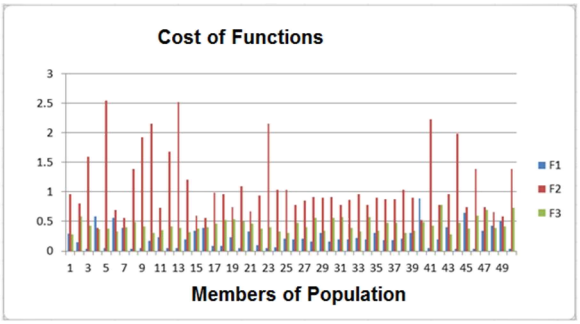

Fig. 3. Cost of functions

As in the previous section formula has three main functions is to optimize the value of each function in the vertical axis of the graph is visible. In fact, the cost function is given on the vertical axis[27][28].

F (1) is equal to Th offload.
F (2) is equal to R offload.
F (3) is equal to the energy equation.

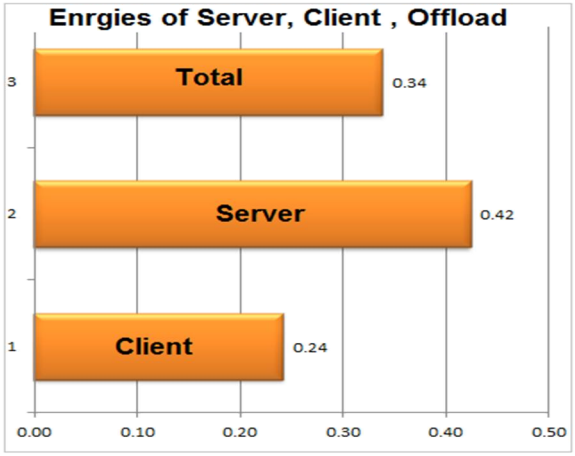

Fig. 4. Compares of client, server and offload energies

1: x (9) Energy of client
2: x (10) Energy of Server
3: x (11) the total energy

Energy compared to client-server energy and energy shows the percentage of total energy consumption Client or Client Server and energy to the total energy is less than or Overhead[29][30].

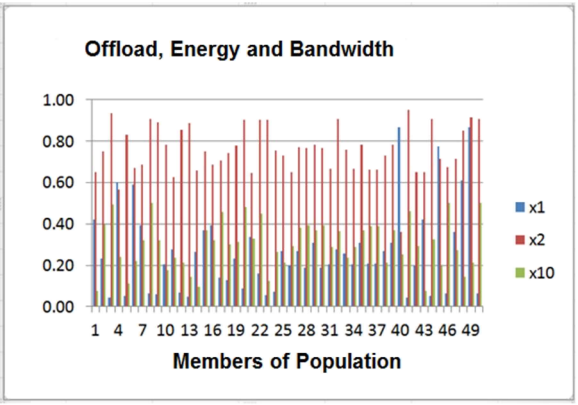

Fig. 5. Compare of offload, energy and bandwidth values

x (1) The number of bytes transferred
x (2) is a random value between zero and one offload percent.
x (10) Energy Server
Diagram of the Offload to reverse shown that 5% of the sample population Offload number of bytes transferred is equal to 20% of energy consumption by about 5% and about 10% is server.

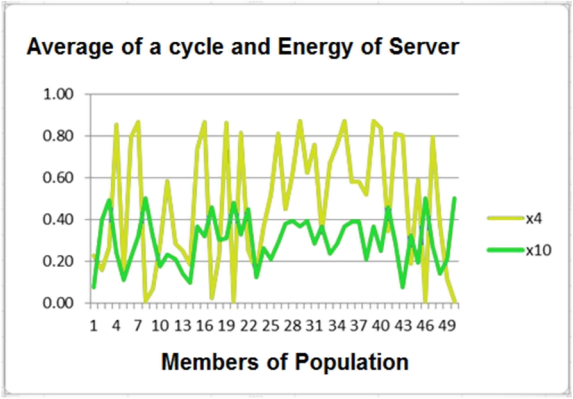

Fig. 6. Average of a Cycle Time and Energy of Server

x (4) the average duration of a complete cycle - new
x (10) Energy Server
Figure 1 indicates that the sample population average for a cycle time of 10% to as much as 22% of energy is consumed in the server.
The simulation results of the project on the parameters x (3) the average duration of a complete cycle-Old and x(13) indicates that the server throughput and increased response time, power consumption is reduced. Other articles Simulation results show average power consumption and cycle time proceed in parallel with each other; there is a direct relationship between them. Compare two methods show the result of the work on this project with the increase in response time, power consumption is reduced in the articles is the relationship between these two measures directly[31][32].

3. CONCLUSION

The basic idea of cloud computing, mobile, off-load processing tasks to the cloud, the cloud is done, and then the results are transferred to a mobile device. It can lower energy consumption in mobile devices. Cloud can use the mobile network or is accessible over the WAN. The wide area networks will be available periodically. That it can provide significant advantages in terms of cost and energy. In this paper, NSGA II optimization algorithm to optimize the parameters simultaneously, without time and energy is spent. The parameters of the proposed algorithms are designed in a way that would have been converging to the optimal. According to NSGA II algorithm in Matlab software simulation output results of the ranking member on several fronts, the optimal percentage of idle energy consumption at the client side, bandwidth and the average duration of a cycle, the different generations compared with each other and with other papers that show the performance improvement of the proposed method in this project.

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