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An Efficient Health System Using ICPSO

A Thesis
Submitted to the Department of Computer Science\ College of Sciences\ University of Diyala in a Partial Fulfillment of the Requirements for the Degree of Master in Computer Science

By

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2019A.D **Iraq** **1441A.H**

بسم الله الرحمن الرحيم

ويسألونك عن الروح قل الروح من أمر ربي

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Dedication

To …
Our Prophet Mohammed
Peace
be Upon Him (PBH)
My dear parents
My sisters and my brothers
My friends
I produce this work with all

Reem Majid

Acknowledgment

First of all, praise is to Allah, the lord of the whole creation, on all the blessing was the help in achieving this research to its end. I wish to express my thanks to my supervisors, Prof.Dr. ***Dhahir Abdulhade Abdulah*** *for supervising this research and for the generosity, patience and continuous guidance throughout the work. It has been my good fortune to have the advice and guidance from them. My thanks to the academic and administrative staff at the Department of the computer sciences.*

I would like to thank my family who have supported me throughout the past two years and encouraging me to further my studies and help to complete this master project.

Reem Majid

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List of Abbreviations

Abbreviations	Meaning
HCS	Health Care System
IoT	Internet of Things
MBAN	Medical Body Area Network
WSN	Wireless Area Network
BAN	Body Area Network
BSNs	Body Sensor Networks
HTTP	Hypertext Transfer Protocol
COAP	Constrained Application Protocol
MQTT	Message Queue Telemetry Transport
VM	Virtual Machine
PSO	Particle Swarm Optimization
IPSO	Integer PSO
BPSO	Binary PSO
VPSO	Veeramachaneni PSO

PPSO	Pugh PSO
AMPSO	Angle Modulated PSO
ICPSO	Integer and Categorical PSO
ICU	Intensive care unit
AT	Arrival Time
CT	Completion Time
TT	Turnaround Time
ATT	Average Turnaround Time
WT	Waiting Time
AWT	Average Waiting Time
BT	Burst Time
CPU(U)	CPU Utilization
ACPU(U)	Average CPU Utilization

List of Algorithms

Abstract

Health care systems based Internet of Things (IoT) and cloud computing service play a significant role in Information and Communication Technologies and has a contribution in the development of medical information systems and monitoring patient health care.

The goal of system the proposed to find best server (VM) when exist IoT network that be large data from MBAN develop the healthcare methods performance by decreasing the MBAN user cost time of implementation storage large data of patients optimization the essential ,offering a actual time so that time and cost are saved in healthcare system. Furthermore, it aids the MBAN to decrease their time of waiting, time of turnaround for medical needs on the cloud environment, lessen CPU waste utilization of VMs, and exploit resources utilization.

The proposed system architecture cloud-IoT contains of four key components: devices of the (MBAN user), IoT Router, broker of cloud and server of cloud HCS . To enhance the (VMs) selection by , the proposed algorithm utilizes localized joint probabilities between pairs of state variables to represent dependencies explicitly called (ICPSO) algorithm used to construct a suggested system.

A compute the cost time speed of (MBAN user) needs, the suggested fitness of function be present a composited of seven essential attributes that utilization of CPU, turnaround time and time of waiting, execution speed time, physical no latency, physical latency, cost time and three secondary arrival times, completion time ,barst time.

The proposed system is verified with previous works to assess its efficiency. The simulation results appearance that the proposed system evaluated performance efficiently of the proposed algorithm

(70.713%) when exist physical network latency, (50.704%) when no exist physical network latency. Average time of CPU is (2 milliseconds). Improvement of the suggested system over the Previous study is (28.44%) when no network latency is considered and (31.77%)when the physical network latency parameter is considered.

Chapter One

General Introduction

Chapter One

General Introduction

1.1 Introduction

Health system (HS) are considered of the most medical fields of interest to the world at the present time. The optimal use of HS saves many people from death. Stakeholders of the HS such as the patients and the doctors use traditional methods to retrieve patients data to find out the patients' health condition in a long time, but using modern methods such as cloud computing can retrieve patients data in less time and less cost. The medical researches concentrate on human health in the areas of health monitoring, health data archiving, the doctor patient interaction recent years, anticipations about keeping patient data and health services become difficult operation. [1].

A large set of 'IoT' is currently being used in healthcare, which results in a large volume of data. To analyze, store, and pre-process the large variety, volume, and veracity of data, cloud servers are used worldwide. The cloud is currently the only available feasible solution for communications among healthcare 'IoT' [2] .

Cloud computing ease the burden of healthcare 'IoT' devices by removing battery draining computational tasks. The cloud is the only place for the analysis, filtering, pre-processing, and aggregation of data generated from healthcare 'IoT' devices. However, the cloud has its limitations concerning healthcare 'IoT'.

Owing to the increasing transmission and the determination of these high volumes of data, the reaction time in cloud Computing is increasing as well. An upsurge in reaction time results in a higher service latency to end users [3].

For large data transmissions, more data are transmitted over a network, hence the higher probability of an error occurring and scheduling task. Packet loss and transmission latency are proportional to the amount of data transmitted from 'IoT' to cloud servers. This causes a poor quality of service (QoS) to end-users [4]. In many time-critical applications of the IoT, cloud-scale processing and storage are not required. Extreme time-bounded selections should be made closer to IoT devices. The healthcare infrastructure requires real-time data for time-sensitive applications. The critical requirements for healthcare 'IoT' are minimum latency and network bandwidth conservation [5]. The cloud and end-devices are connected via routers and gateways. Therefore, a large number of routers are placed between healthcare 'IoT' and the cloud. These routers incur computation delays. The larger the distance, the larger is the number of routers used between the source and destination. Data travel a long route from end-devices to a cloud server and consume a high bandwidth [6].

Cloud computing can perform an important role in containing healthcare costs, optimising resources and ushering in a new period of innovations. Current orientation target towards accessing data anytime, anywhere, which can be accomplished when moving healthcare data to the cloud computing and scheduling task to server using heuristic algorithm Integer and Categorical Particle Swarm Optimization (ICPSO) is a new discrete particle swarm optimization algorithm that is designed to handle both integer and categorical state variables [7].

The objective of the scheduling problem is to minimize the total cost of each task during the process in the cloud computing network generally, the thesis enhances user application and minimizes the cost execution time in order to give vast benefits to the both patient and workers medical.

2.1 Related Work

This section reviews some of previous studies and explains the different techniques that are used for developing and enhance scheduling and performance of VMs in a cloud-IoT environment for health system as follow:

1- S.D.Yu and et al (2014)[8]: The propose a distributed parallel genetic algorithm (DPGA) of placement strategy for virtual machines deployment on cloud platform. It executes the genetic algorithm parallel and distributed on several selected physical hosts in the first stage. Ten it continues to execute the genetic algorithm of the second stage with solutions obtained from the frst stage as the initial population. the solution calculated by the genetic algorithm of the second stage is the optimal one of the proposed approach. The experimental results show that the proposed placement strategy of VM deployment can ensure QoS for users and it is more effective and more energy efficient than other placement strategies on the cloud platform.

2- A.T. Parmar and et al. (2015)[9]: The presented an approach to find optimal VM allocation in cloud environment based on FCFS algorithm. This study tries to find optimal VM allocation to reduce energy consumption, reduce time from users' tasks and facilitate task scheduling.

FCFS algorithm may discover optimal VM allocation in cloud computing environment. But, it needs to improve task scheduling.

3-M.M . Rathore, et al. (2016)[10]: They proposed IoT-based Real-time Medical Emergency Response System by exploiting Big Data analytics. The proposed system involves a different aspect of hospitals, emergency services, first aid, and police stations. The view to developing continuous follow up and monitoring individual vital signs anytime anywhere anyhow, a flexible system was designed based on Intelligent Building that analyzes the data received from various medical sensors attached to various persons. The system was implemented using hadoop ecosystem and Spark as a real-time processing tool. The performance of the system was tested on a hadoop. The evaluation showed that the performance of the proposed network architecture fulfills the required needs of a city or nation, whether the input data are real time or offline, while taking actions in real time.

4-S.D. Ebrahim and et al. (2016) [11]: The proposed to obtain the optimal VM placement based on modified PSO algorithm. This study tries to find the best VM placement to give the quality of services of users' tasks and minimize energy consumption. This proposed method can find the optimal VM placement by a modified PSO algorithm to save power consumption and facilitate task scheduling.

5- J. Hanen and et al. (2016) [12]: The proposed system to help patients to treat heart rate signal remotely based on medical cloud computing system (MCCS). MCCS is applied to Google's Android operating system and CloudSim for solution traditional problem in analysis heart rate .

MCCS may find the better solution for analysis heart rate signal on mobile cloud computing.

6- S. Luo and el al (2016)[13]: The proposed system remote monitoring cloud platform of healthcare information (RMCPHI) was established firstly. Then the RMCPHI architecture was analyzed. Finally, an efficient PSOSAA algorithm was proposed for the medical monitoring and managing application of cloud computing. Simulation results showed the proposed scheme can improve the efficiency about 40%.

7- A. Abdelaziz, and et al. (2017)[14]: This paper proposes a new intelligent architecture for HCS. also, this paper proposes three intelligent algorithms are a genetic algorithm (GA), particle swarm optimization (PSO) and parallel particle swarm optimization (PPSO) to find optimal chosen of VMs in a cloud environment. For that, this paper uses MATLAB tool to find optimal intelligent algorithm and cloudsim to find optimal chosen of VMs in a cloud environment. The results proved that PPSO algorithm is better than GA and PSO algorithms.

8- M. Elhoseny and et al. (2018)[15]: This proposes a new model to optimize virtual machines selection (VMs) in cloud-IoT health services applications to efficiently managea big amount of data in integrated cloud IoT. The proposed model is implemented using three different proposed algorithms using GA, PSO, and PPSO optimizers. The proposed model aims to find the best selection of VMs to help stakeholders in reducing execution time. The proposed model is tested against the state-of-the-art method to evaluate its effectiveness. The results show that the proposed model outperforms on the state-of-the-art models in total execution time the rate of 41.8%. Also, The results show that the proposed model dramatically improves the system efficiency by 5.2%.

9- R .O. Aburukba and et al.(2019)[16]: This work modeled the scheduling problem for IoT requests to minimize time in hybrid Fog-Cloud computing using integer linear program in order to minimize time the overall service request task. This work presents a customized implementation of the genetic algorithm (GA) as a heuristic approach to schedule the IoT requests to achieve the objective of minimizing time the overall job. The GA is tested in a simulation environment that considers the dynamic nature of the environment. The performance of the GA is evaluated and compared to the performance of waited-fair queuing (WFQ), priority-strict queuing (PSQ), and round robin (RR) techniques. The results show efficient for the proposed approach is 21.9% to 36.6% better than the other algorithms. The proposed approach also showed significant improvement in meeting the requests deadlines by up to 20%.

Therefore, the proposed system can be differentiated from the above state-of-the-art method by offering ICPSO algorithm for improvment scheduling MV depented probablity distributing in a cloud computing find best sever reduce cost time healthcare applications and flag alert for monitoring server.

1.3 Problem Statement

The problem of scheduling tasks and work in the cloud computing has become one of the most important growing problems experienced by the health care system in the intensive care unit, which is based on IoT technologies, the area of the medical body in monitoring the patient continuously in real time remotely that generates large data that needs processing and analysis service And storing them very quickly and this causes many problems in delaying the implementation time or giving

priority to implementation according to the type of tasks traffic congestion so the care system based on patient monitoring needs a more effective way to reduce the implementation time.

1.5 Aim of the Thesis

The aim of this work is to design, implement and handle task scheduling patient data vital indicators (blood pressure (systolic ,diastolic), heart rate and glucose level), cloud computing, intensive care unit, using the modified technique discrete (ICPSO)algorithm, which depends on the possibility of distribution, to find solutions in reducing time cost implementation, patient status monitoring and data analysis using flag.

1.6 Outline of Thesis

The other chapters in this thesis are as follows:

Chapter Two: Theoretical Background

This chapter presents the explain IoT technology and healthcare system in IoT and cloud computing technology and technique using scheduling cloud.

Chapter Three: The Proposed System

This chapter describes the proposed system with its design and implementation.

Chapter Four: Experimental Results and Evaluation

This chapter explains the results and evaluation that have been getting from the proposed system.

Chapter Five: Conclusions and Suggestions for Future work

This chapter gives a list of conclusions derived from the results of the presented work and some suggestions for future works.

Chapter Two

Theoretical Background

Chapter Two

Theoretical Background

2.1 Introduction

In the current chapter the basic theoretical aspects of technology 'IoT' and cloud computing efficient in health system services are presented, a brief introduction to health system is given and how the technology wireless body area network works the which can be used to measure the medical physiological signal. It presents the background for various necessary preprocessing issues and techniques that had been used in this work.

2.2 IoT

'IoT' is a new revolution of the internet thanks to the ability to connect remote and mobile things or machines or assets through the use of wireless communications and low cost sensors computing and storage devices. So, the internet is now advancing from a network of computers to a network of things [15]. 'IoT' is one of the most promising technologies in Information and Communication Technology for the last decades. At the center of the 'IoT' paradigm lies the idea of adding more identifying, sensing, computing and communication capabilities to physical devices that previously not designed for this purpose. 'IoT' really does is to transform data into information, knowledge and finally wisdom. As a result, humans can build a holistic view of the object of interest and act accordingly [16].

Especially in the field of sustainability, 'IoT' helps to collect different environmental parameters effortlessly and eventually turns them into statistics, knowledge and actions. There is a long list of current 'IoT' applications, and the list is still going on. 'IoT' is currently present in (energy management, environmental management, healthcare, transport and traffic management, logistics, and inventory management [17].

All applications of 'IoT' can be grouped into four main application domains:

1- Transportation and logistics.
2- Healthcare system.
3- Smart environment (home, office, plant).
4- personal and social.

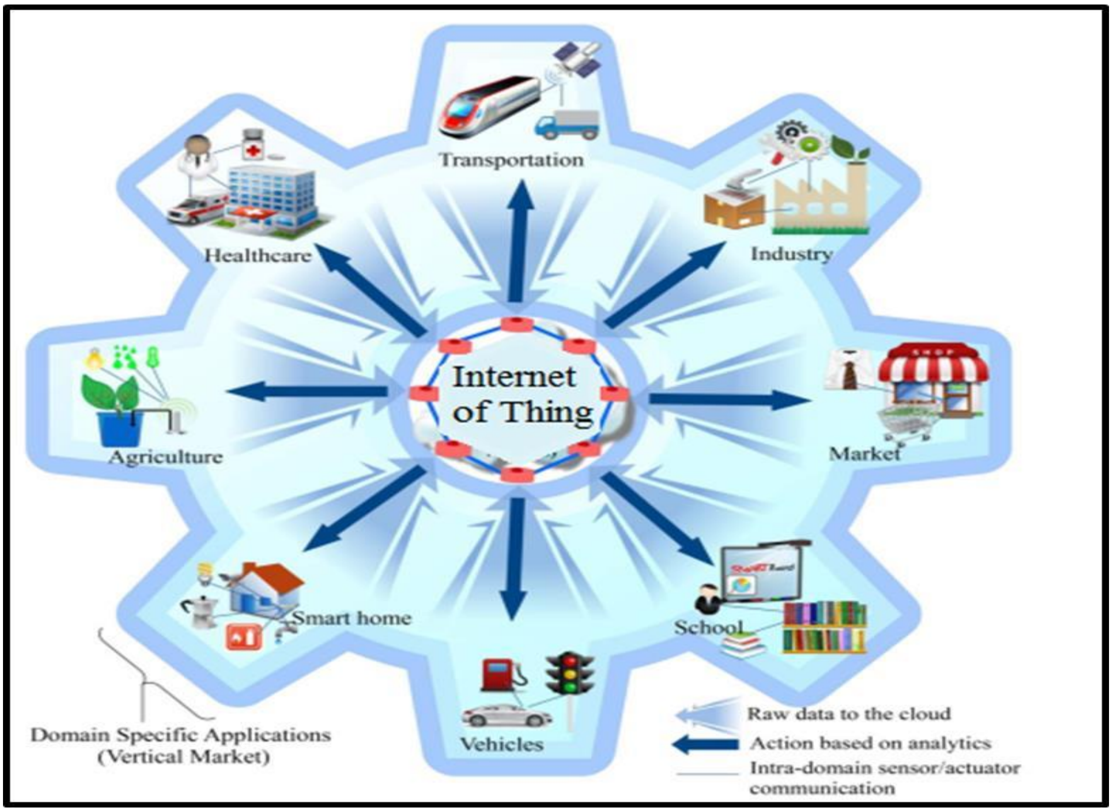


Figure (2.1): Illustrates the 'IoT Applications Domain Specific [16].

2.2.1 IoT in Health System

In this part, one of the most important applied areas of life is explained in the field of health care, which depends on iot technology, cloud computing.

'IoT' based health care systems play a significant role in information and communication technologies and has contributed in the development of medical information systems. The developing of 'IoT' based health care systems must ensure and increase the safety of patients, the quality of life and other health care activities.The tracking and monitoring of patients and health care, actors activities are challenging research directions [18].

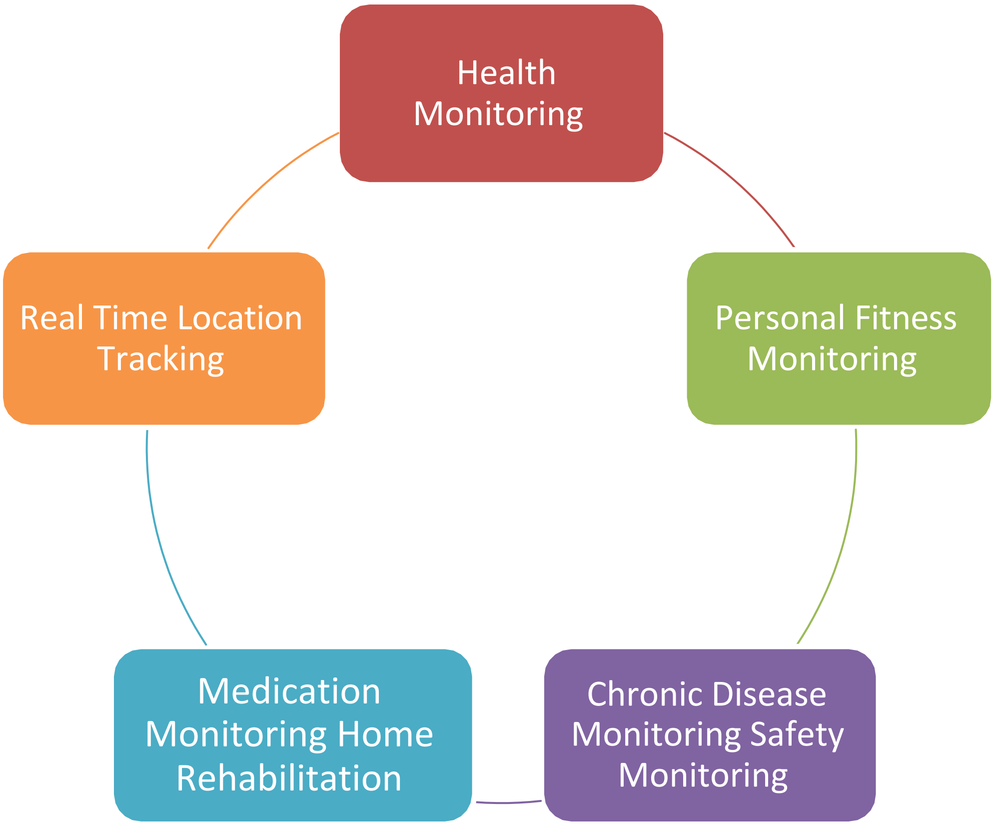
The development of health care systems demands a concerted effort to harness the power of information and communications technologies in the service of health care in order to create more (efficient, effective, and secure data sharing, large scale health information processing, and more effective communications) [19].

The main idea of applying 'IoT' in healthcare is move out from traditional area to visit hospitals and waiting will come to an end. The concept here is that it can be able to sense, process moreover communicate with biomedical and physical parameters so that they can work on it. The view is to connect the doctors, patients via smart device and each entity can roam without any restrictions. The idea is constant monitoring of patient take some important information and upload it to doctor’s side then he can suggest further steps to be followed [20].

'IoT' is an important factor in the big data movement. Due to its extensive coverage of sensors and the demand to sense continuously, IoT is expected to generate data that is huge in terms of volume and velocity. The data velocity challenge poses a big load on data management technologies, since the data arrival rate can be millions of element per second. As a result of this, the next challenge coming from 'IoT' is real time data processing, since much of the value of 'IoT' is the ability to respond to a trigger in real time. The volume of data from 'IoT' applications can be too large come leveraging from cloud computing technology to solve problems big data that generates sensor devices [18].

A- Functions of IoT in Medical system

Here are a few of the functions that Internet of Things devices and technologies have in health system. 'IoT' could have various applications in the medical industry for improving the quality of life, saving lives and reduce treatment cost. By using 'IoT' based technologies, the medical industry can improve the ability of the healthcare system in minimizing human error, simplifying the treatment process and quality of life for the caregiver as well patient. 'IoT' based monitoring system can help doctors in treatments and predict a symptom before starting diagnosis. A monitoring system can also alarm in medical emergency situations like patient has abnormal behavior changed sign vital physiological as in the intensive care unit [20].



Figure(2.2): Shows The Functions IoT of Health Care System [20].

B- Advantages of IoT in Medical System

The overall importance of healthcare software solutions is difficult to overestimate as technology promises to make healthcare services more effective and alleviate the burden placed on healthcare providers. This is critical in the context of the aging population and the increase in the number of chronic diseases [21].

1. **Remote monitoring**: Real-time remote monitoring via connected IoT devices and smart alerts can diagnose illnesses, treat diseases and save lives in case of a medical emergency.

2. **Prevention**: Smart sensors analyze health conditions lifestyle choices and the environment and recommend preventative measures, which will reduce the occurrence of diseases and acute states.
3. **Reduction of healthcare costs**: IoT reduces costly visits to doctors and hospital admissions and makes testing more affordable.
4. **Medical data accessibility**: Accessibility of electronic medical records allow patients to receive quality care and help healthcare providers make the right medical decisions and prevent complications.
5. **Improved treatment management**: IoT devices help track the administration of drugs and the response to the treatment and reduce medical error.
6. **Improved healthcare management**: Using IoT devices, healthcare authorities can get valuable information about equipment and staff effectiveness and use it to suggest innovations.

C- Problems of IoT and Health Systems

IoT integrated healthcare systems including accessories and other equipment remain most of the time with them and keep tracking and monitoring them, they are constantly getting information about them and sending it over the cloud. So these technologies are closely linked with the patient’s privacy and more importantly health and also with their routine life activities.

Since these technologies are linked with their life so they can understandably affect them as well. So these aspects should be taken care of while designing, manufacturing and integration of the IoT in the healthcare systems and devices. Let's have a look at some of the problems associated with the IoT integrated healthcare systems one by one [21, 22].

A-Privacy : There have been instances of cyber-attacks on medical sector lately, integration of IoT technologies and being continuously connected of the healthcare systems and devices with the internet have made it prone to cyber-attacks. So this way the confidential data of patients is at risk of being stolen.

B- Uninterrupted connectivity: Since the major function of the IoT integrated medical care systems and devices is their ability to keep it connected with the healthcare facility, so a faultless and secure internet connection needs to be present all the time and everywhere where IoT integrated healthcare systems are being used.

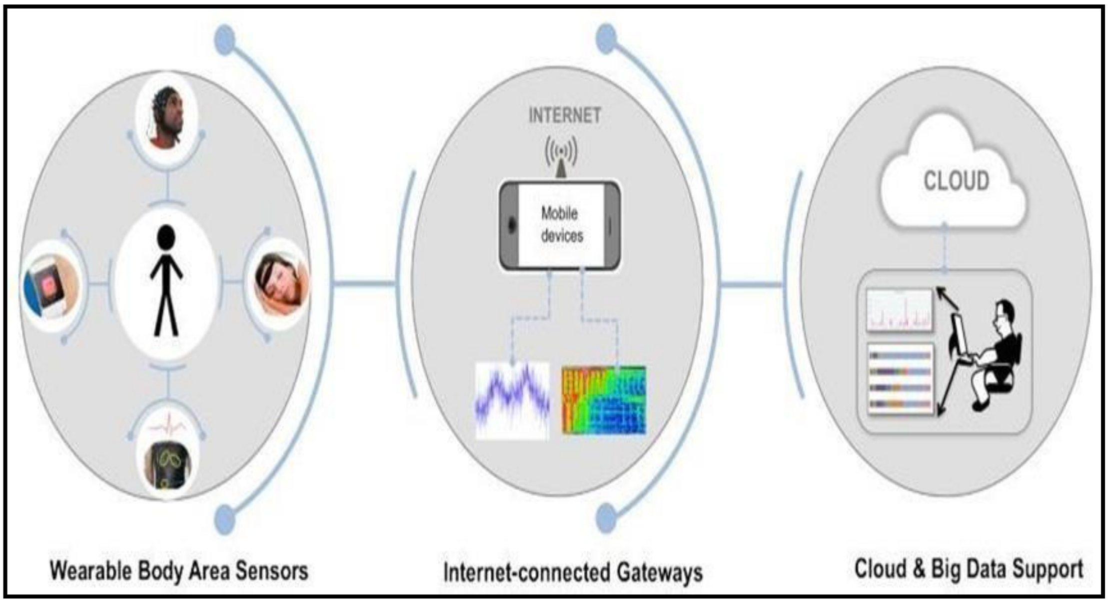
C-Round-the-clock Maintenance: The maintenance of such systems is quite complicated task for which the health centers need to have competent and efficient Information Technology team which can handle these scenarios well.

2.2.2 IoT in Health Monitoring Systems

Patient health monitoring can be performed either with direct contact or remotely. In recent years, there has been a focus on remote health monitoring in order to alleviate the responsibilities of medical professionals [23]. Remote patient health monitoring is supported with eHealth . eHealth refers to the ubiquitous provision of health care services supported by modern communication infrastructures and electronics. On the other hand focuses on patient health monitoring by use of mobile devices. Both eHealth necessitate a total reform of the health care and patient monitoring through digitalization . Real-time monitoring of patients through use of Current state of the art systems in the patient health monitoring area focus on systems being wireless and wearable [24].

2.2.2.1 Wearable Health Monitoring Systems

Wearable health devices are becoming important ambulatory monitoring systems helping in medical prediction, anomaly detection and diagnosis. One of the problems is the limited number of measured physiological parameters. Many wearable device are developed with the aim to acquire only one physiological sign measurement, adapting its design and use to that only parameter[25].



Figure(2.3): Examples of some wearable health devices [25].

One of the first's devices of this type was AMON first presented in 2002 and capable of monitoring heart rate, blood oxygen saturation and skin temperature, already with a wireless data communication module. More recently, a new smart watches generation is emerging with wireless and mobile communication, able to provide more than 24 h of vital monitoring .IoT wearable devices "medical sensors" records patient health related information like blood pressure, body temperature and blood glucose and heart rate, etc. This data will be delivered to concern hospital or caretaker for further action [24].

Wearable IoT can be defined "as a technological infrastructure that interconnects wearable technology such as Bluetooth, used to exchange data with wearable sensors and of heterogeneous networks, such as wi-fi used to send the data to the cloud" . Wearable IoT define "body medical sensor" [24].

2.2.2.1.2 Body Area Networks wearable device Health System

Body area networks (BANs), also known as body sensor networks (BSNs), act as the backbone for patient health monitoring. Sensors are strategically placed on the human body and networks are used to continuously monitor body activity and surrounding environments [25].

Wearable sensor as medical body area network and implant sensor. They are required to be characteristic of (low power consumption, small and lightweight, reliable wireless communication function and minimally invasive to human body). The advantage of wearable sensor is its convenience to use. However, its application is restricted since the sensing mode that is limited to the body surface is confined [26].

Their results suggest that currently available devices may not have the accuracy and precision for reliable clinical decisions, and there is a need for better devices. We evaluated the CareTaker (CT) device which has been described in detail elsewhere. Briefly, the CT is a physiological sensing system that communicate physiological data wirelessly via Bluetooth (Figure 2.4). Cuff surrounding the proximal phalange of the thumb that pneumatically couples arterial pulsations via a pressure line to a custom-designed piezo-electric pressure sensor [27].

This sensor converts the pressure pulsations, using trans impedance amplification, into a derivative voltage signal that is then digitized at 500 Hz, transmitted to and recorded on a computer.

CareTaker is the worlds most innovative vitals signs monitor, capable of measuring Continuous “Beat by Beat” Blood Pressure , Heart Rat other

parameters using only a comfortable finger cuff. caretaker is purpose-built to either be worn on a patient's wrist to measure continuous vital signs with

maximum mobility, or to be used periodically by patients being monitored remotely. Using the on-board Bluetooth Radio, caretaker can gather and report info from other Bluetooth devices , and display the data on our Secure, caretaker compliant web-portal or display information securely tablets, computers, or nurse monitors [28].

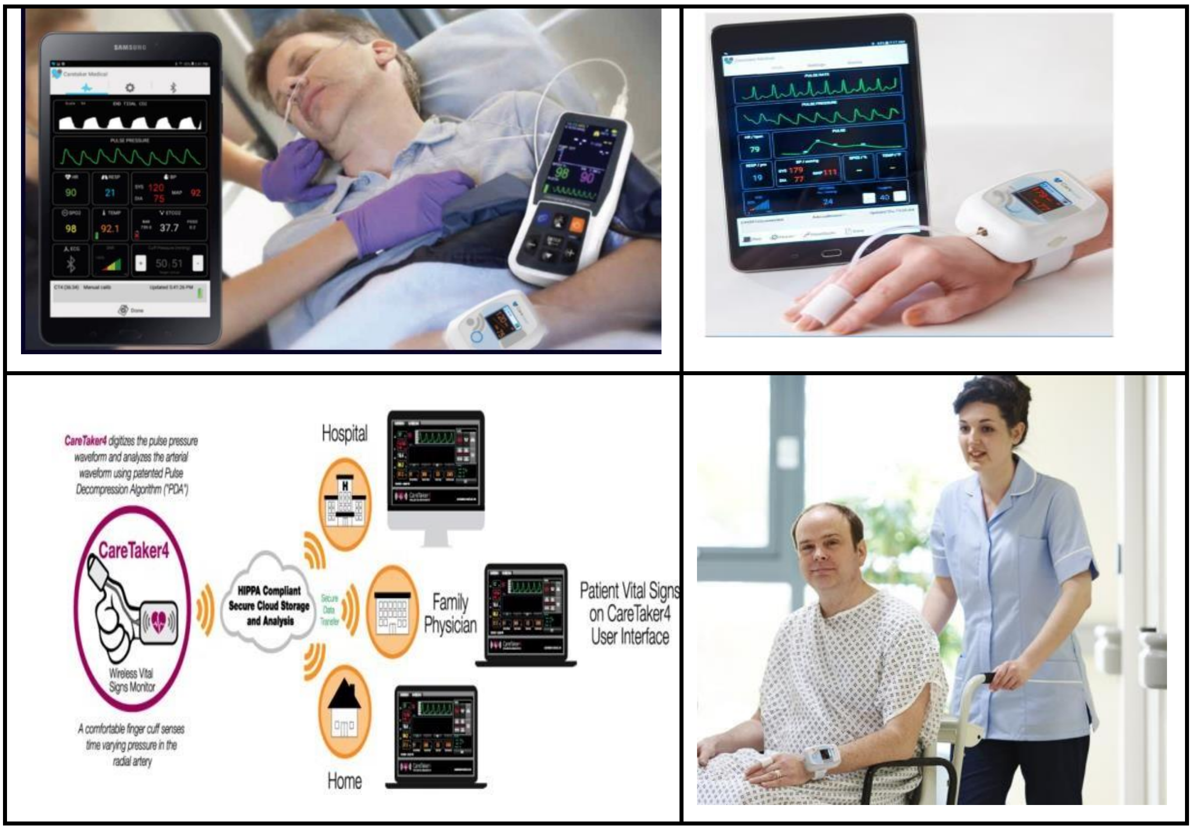


Figure (2.4): CareTeker WirelessWearable Health Monitoring System [28].

Caretaker's integrated multi-mode radios are configured gured to securely transmit data over cellular networks or to Bluetooth devices without the need to implement complex communications or connectivity networks.

Clinicians simply attach the finger cuff and wrist unit to patients and immediately begin measuring vitals and the data on a tablet or connected nurse station monitor, alternatively, the data can be transmitted directly into the Patient’s Electronic Medical Record (EMR).

Because caretaker has an integrated low-energy bluetooth radio, it can function as a wearable Hub, collecting data from other bluetooth devices such as glucose blood ,heartrateb data can it provide[29].

1- Uses a comfortable Finger cuff to sense the arterial pulse pressure waveform

2- Gathers physiological parameters from Bluetooth devices such as blood press, glucose blood, heart rate , weight scales.

3- Analyses arterial pressure waveform using caretaker’s Patented Pulse Decomposition Algorithm (PDA).

4-Transmits encrypted vital sign data wirelessly to a secure cloud or to a Bluetooth device.

2.2.2.2 Physiological Measurements Monitoring

1- Blood pressure

Is measured using a blood pressure monitor which may be wired or

wireless. The monitor can take the form of an arm cuff, a wrist cuff or a finger cuff.

The cuff will automatically inflate to cut off blood flow and then slowly release. Points at which the blood flow starts and stops are recorded as the systolic and diastolic values respectively proposed an experimental watch-

type prototype which uses a pressure sensor near the radial artery, giving an accurate blood pressure measurement on a personal smart phone, a real-time continuous monitoring BP wearable device [30].

2- Heart Rate

According to the National Institute of Health and American Heart Association, the average resting heart rate for adults is between 60 and 100 beats per minute. Continuous and repeated high heart rate (>100 beats per minute) readings are a sign of tachycardia and can lead to the disruption of heart functions[31].

3- Blood glucose

Is a worldwide measurement need in diabetic subjects. It is not measured in a normal procedure of a clinical environment but is important in diabetic global population. The most used method to evaluate BG concentration is collecting a blood sample by pricking the finger with a lancet. There has been a lot of effort to prevent finger pricking and as a result, several devices have been developed and are already in the market that has the purpose to continuously measure BG levels still using wireless methods [31].

2.2.2.3 Communication Technologies IoT

Wireless network here are a variety of wireless communications which can transmit data. Communication standards part of the IEEE 802.15 Working Group enable wireless personal area networks (WPAN).

These standards include Bluetooth, ZigBee and wirless wifi. The IEEE 802.15 Working Group supports wireless technologies essential for the

transmission of data collected from sensors to monitoring applications and vice versa [32].

- **Wi -Fi :** Is usually deployed and selected for a wireless network, especially for high data rate applications , power consumption is the highest among these wireless technologies[32].
- **ZigBee:** One single wireless technology may not be sufficient to cover both short and long range applications is specifically designed for low cost and low rate wireless personal area networks. It supports reliable data communication and maintains a simple and flexible protocol stack]. This standard creates the building blocks for further protocol stacks [32]**.**
- **Bluetooth :** is specified by the IEEE 802.15.1 standard and is the most commonly used form of short-range wireless communications. Bluetooth radios operate at 2.4 GHz, and has a data rate of 1 Mb per second. The Bluetooth protocol can handle the transfer of data in the form of voice, images and files in ad hoc networks. It has a Personal Operating Space (POS) of 10 meters. An advancement of standard Bluetooth is Bluetooth Low Energy (BLE) or Bluetooth Smart. The purpose of BLE was to consume less power than standard Bluetooth whilst also transmitting small packets of data. This technology is one of the frontrunners to connect the Iot[33].
- **MBAN :** is a medical body area network (BAN) composed of low-power wearable or implanted wireless medical devices. Wearable devices are typically low-cost, disposable sensors that stick to the body and free the patient from being being physically tethered to monitoring devices.

Embedded devices may be sensors that are swallowed for short-term monitoring or placed in the body during surgery to monitor physical parameters during and after the healing process[34].

The sensors transmit patient data wirelessly to a control device located either on the patient's body or in close proximity to it. The control device, which functions as a message broker, forwards data from the sensors to a workstation in real time over a wireless local area network (WLAN).

The dedicated spectrum for medical data has made medical data transmission both more reliable and faster and prevented interference from Wi-Fi devices. Body area networks employ features which are better aligned with patient health monitoring in comparison to traditional wireless sensor networks (WSNs), divide king wearable on body and wearable in body [33].

Table (2.1): Comparative between WBAN and WSN

Issues	WBAN	WSN
Node size	Small is essential	Small is preferred ,but not important
Scale	Human body (centimeters/m)	Monitored environment (meter/km)
Node task	Node performs multiple task	Node performs a special task
Node number	Fewer, limited in space	Many redundant nodes for wide area coverage
Accuracy	Through node accuracy and robustness	Through node redundancy
Security level	High	Low

Category of medical applications related to the wireless technology, and point out the ones able to support and satisfy these requirements the specific requirements of WBAN are mainly [34,35].

1- **Reliability:** Data sent by WBAN sensors concern heath information for which high reliability is required.

2- **Latency:** Some medical applications handling emergency data cannot tolerate long response time. Thus, real-time transmission with performance guarantee is required. For a continuous 24/7 remote health monitoring system, rapid decision making and agile responses are essential for several acute diseases and emergencies, where data processing and transmission time should be minimized. In cloud computing where raw data is transferred from sensor nodes to cloud Comparatively, implementing high priority data analytics in distributed smart gateways and making critical and time-sensitive decisions within the local network make the system more robust and predictable. The processed data can be then transmitted to the cloud for storage and further analysis.

3- **Security:** such systems handle personal and critical data; the security and privacy of such data are becoming important issues.

4- **Power consumption:** Battery replacement in WBAN is easy and so there is less focus on power consumption.

2.2.2.4. Networking protocols for IoT

The most popular application protocols used in IoT communication, namely hypertext transfer protocol, constrained application protocol and message queue telemetry transport [35].

- ***Hypertext Transfer Protocol (HTTP)***

Is a request response protocol used in client server computing model for example a web browser and server for example an application hosting a website .

- ***Constrained Application Protocol (COAP):*** Is a dedicated web transfer protocol for use with constrained nodes and constrained networks. CoAP is usually interchangeable in M2M interactions .
- ***Message Queue Telemetry Transport (MQTT)***: Is a lightweight message protocol on top of the TCP/IP protocol it is widely used in M2M communication for IoT devices. It features a lightweight header size of 2 bytes and reduced clients footprint. MQTT adopts the publish and subscribe model .The MQTT architecture includes the publishers, the brokers and the subscribers. The broker receives the subscription from the clients on the topics they are interested in, at the same time it receives message from publishers and forward them, clients publishers and subscribers subscribe and publish on topics [36].

2.3 Cloud computing

Cloud computing is a model for enabling convenient on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [37].

The key challenges in designing such a cloud based healthcare system are outlined.

1- Data heterogeneity: Patients may use assortment of health observation tools such as weight scales, blood pressure monitors or other wireless devices available in the market to monitor their health data. The collected data often have missing values and may arrive in different formats making it difficult to process in a uniform way.

2- Data size: Monitoring, processing and transfer of user health data can go up to twenty four hours a day, seven days a week and three hundred 65 days a year depending on patients' cases. These massive health data sets require to storage and retained for longer time terms for analysis data with increased quality.

3- Data costs: Cost reduction is an important challenge for healthcare service providers to increase its user base.

4- Data security: Security is a significant concern for cloud computing environments where data remains within the perimeter of service providers. The problem becomes even more challenging when the infrastructure is used to host the data of personal medical nature.

2.3.1 Cloud Computing in Health System

Cloud technologies can be implemented in healthcare as a way for preserving patient information, monitoring patients and observation of

Benefits of cloud computing for HCS are as follows[38]:

1- Speed: Cloud services helps to quick access to critical information for health services providers and their patients.

2-Telemedicine: with the spread of mobile technologies and different medical devices, telemedicine has grown to include not only teleoperations, but also health record monitoring, video-conferencing and supported home HCS.

3-Health information exchange: Cloud computing helps healthcare enterprises to exchange information between them to be more visible.

- **Security and privacy:** Cloud services providers are desired to deal with many privacy standards such as Health Insurance Portability and Accountability Act (HIPAA).

- **Decreased costs:** There is no need for the healthcare enterprises to invest in infrastructure such as hardware maintenance, updating of operating system, etc.

2.3.2.1 Service Models of Cloud Computing

Service models provided by cloud computing can be as follows[39]:

1- Software-as-service (SaaS): SaaS provides various software applications which clients can use without having to install them on their machines. These services like e-mail, Facebook and goggle docs are accessible from any device having a web browser.

2- Platform-as-a-service (PaaS): It includes a collection of software development and deployment technologies e.g. operating systems, application development environment, databases and web servers. People can use these services either to host or to develop and test their

applications. Microsoft Azure, Google AppEngine and Amazon Simple database are some examples of PaaS.

3- Infrastructure as a service (IaaS): This model offers an organisation with services like processing, storage and network bandwidth such as AmazonEC2, etc.

2.3.2.2 Healthcare services IoT in Cloud Computing

Healthcare services IoT that are supported by cloud computing are as follows [40,41]:

1- Data management: Is a prime issue in healthcare industry. Point of care centres, particularly, have to store and maintain petabytes of data about human resource, account files and patient medical records including patient history, diagnosis, treatment, dietary information etc.

2- Telemedicine: Recently information and communication technologies have been surged to support and provide patient care services beyond the medical centres. Telemedicine technologies like tele-surgery audio ,video conferencing and tele-radiology bring a new model for collaboration and communication between various healthcare stakeholders.

3- Management information systems (MIS): healthcare industry has initiated using MIS to organise the data influx within and outside the enterprise. Physicians use the system to provide better patient care, customers use it for querying service administrators use this to manage the human resource, billing and finance top management use this system for decision making and forecasting purpose.

4-Clinical decision support system: It is an expert system that emulates the knowledge and behaviour of a medical specialist to generate the advice

upon the analysis of patient record. Doctors as well as patients may use these systems for the diagnosis and medication purpose.

4-General health education: Web is a wealth of information for masses to know about fitness, health, dietary and sanitation issues etc. Majority of people get health related information from the internet using trusted resources like web pages, helper groups and blogs on particular disease type.

Table (2.1) :Complement space IoT and Cloud Computing

Categorize	**IoT**	**Cloud computing**
Displacement	pervasive	centralize
Reachability	Limited	ubiquitous
Components	Real world thing	Virtual resource
Computation capability	Limited	Virtual unlimited
storage	Limited or none	Virtual unlimited
Role of internet	Point of convergence	Mean for delivering service
Big data	sources	Mean to manage

2.3.1Cloud broker

The cloud broker creates the negotiations layer between the stakeholders and cloud service providers where the stakeholders can obtain all of the healthcare services. Cloud broker consists of three types, cloud service intermediation, aggregation and cloud service arbitrage. Cloud broker is represented by (Amazon, Google, etc). Cloud broker is also

responsible to receive data from sensors and to dispatch it to appropriate storage service hosted on the cloud. It also receives requests from content service to database from the Cloud Service [42].

In the evaluation against contemporary cloud providers described in the cloud broker performs two main actions:

1- The optimal placement of the virtual resources of a virtual infrastructure acrossa set of cloud providers.

2-Management and monitoring of these virtual resources based on the infrastructure criteria and constraints provided by the user, the offerings of the available cloud providers, and the used scheduling algorithm, the scheduler component of the cloud broker generates an optimal deployment plan.

The deployment plan embodies an explicit implementation of the user's abstract infrastructure request and it contains a list of VM templates. Each template includes the target cloud provider to deploy the VM as well as attributes specific for the selected provider[41].

2.4 Scheduling Techniques

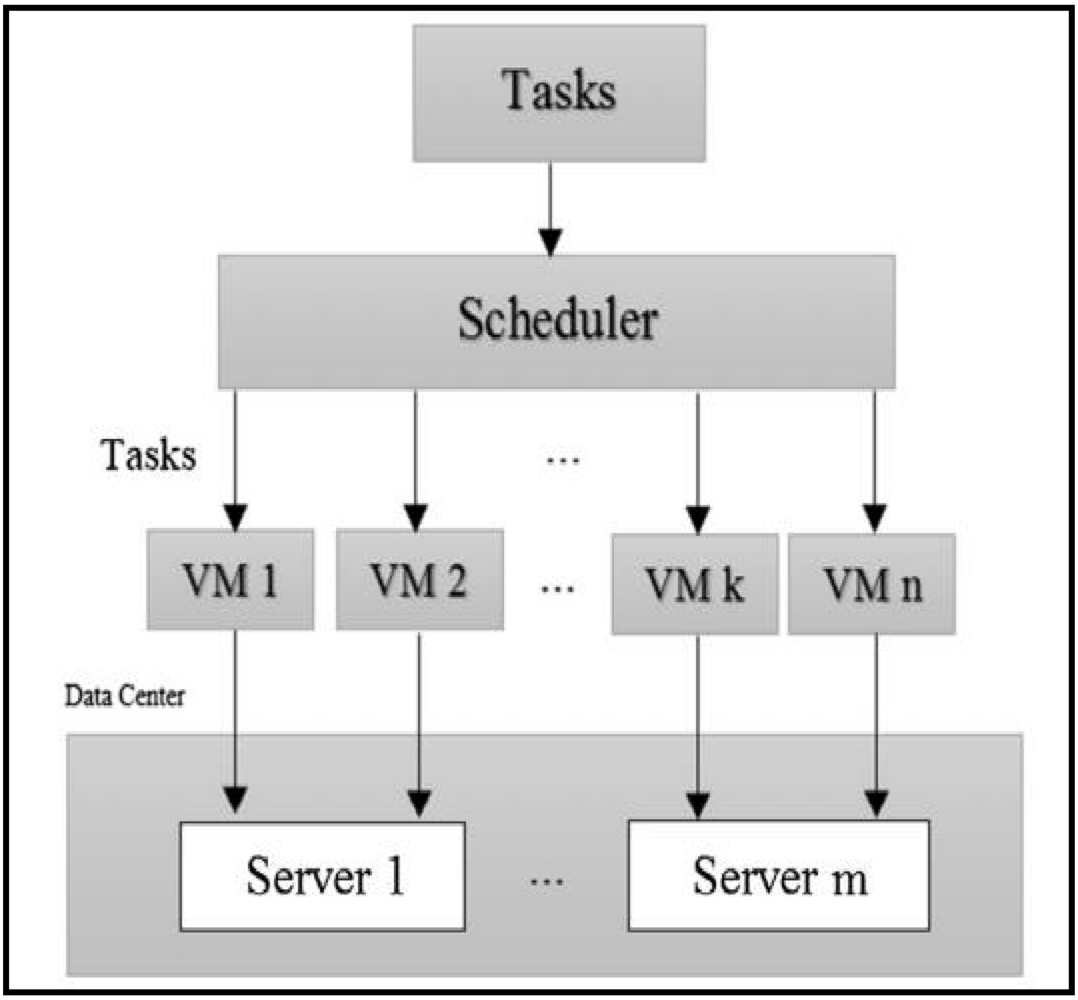
Scheduling is the allocation of tasks to capable resources at a specific time. Usually, a scheduling problem is subject to many constraints and objectives that must be fulfilled. The scheduling problem can be mapped to an optimization problem where the scheduling problem objectives can be, for instance, minimizing latency and maximizing resource utilization.

The work specifies that most of scheduling problems consist of four basic elements [43]:

1. **Resources**: are physical ,logical devices with the ability to execute or process tasks.
2. **Tasks**: are physical/logical operations that need to be executed by the resources.
3. **Constraints**: are conditions that must be considered in scheduling the tasks into the resources. They may be operation-based, task-based, resource-based, or a combination of these. They could also be hard constraints, meaning constraints that must be full-filled or soft constraints can be relaxed.
4. **Objectives**: are evaluation criteria that need to be measured in order to assess the schedule performance. To find a solution to a scheduling problem, there are two broad categories of methods exact methods and heuristic methods. Exact methods find the absolute optimal solution to the scheduling problem. Examples of exact algorithms include simplex and branch-and-bound . On the other hand, heuristic methods do not guarantee finding the optimal solution.

However, they are able to find a solution that has some degree of optimality in a reasonable computation time compared to the time required by an exact method [43].

Examples of heuristic algorithms include: simulated annealing , genetic algorithms , and ant colony algorithms as shown in Figure (2.6) task scheduling tries to map tasks or jobs to the appropriate VMs for achieving objectives such as minimum make span, task execution time, task transferring time, costs, etc [44].



Figure(2.6): Task Scheduling in Cloud Environment [44].

2.4.1 Particle Swarm Optimization Algorithm

(PSO) is a biologically inspired computational search and optimization method developed in 1995 by Eberhart and Kennedy based on the social behaviors of birds flocking or fish schooling. A number of basic variations have been developed due to improve speed of convergence and quality of solution found by the PSO. On the other hand, basic PSO is more appropriate to process static simple optimization problem. Modification PSO is developed for solving the basic PSO problem [45].

(PSO) is a popular metaheuristic designed for solving optimization problems on *continuous* domains. It was introduced by Kennedy and Eberhard and has since then been applied successfully to a wide range of optimization problems. Since the structure of the PSO algorithm is relatively simple (PSO), has to some extent been open for theoretical studies of the swarm behavior. provide analyses of the convergence behavior of particle swarms, which offer some insights on how to select the swarm parameters, and the initial behavior of a swarm has been analyzed in. Inspired by the performance of (PSO), on continuous optimization problems [46].

One of the drawbacks to PSO is that the base algorithm assumes continuous variables. This present a version of (PSO) that is able to optimize over discrete variables. This new (PSO) algorithm, which we call Integer Categorical PSO (ICPSO). several approaches have also been proposed for applying PSO to discrete problems, such as function optimization on binary domains , scheduling problems ,and the Traveling Salesperson Problem (TSP) [46]. A particle *p* sposition in the search space, $\mathbf{Xp} = \{Xp,1;\ X\,p,2\ ;\ldots\ ;\ Xp,N\}$, directly represents a candidate solution.

The particle "flies" through the search space according to its velocity vector $\mathbf{V\ p} = \{Vp,1;\ Vp,2;\ldots\ ;\ Vp,N\}$, which is updated at each iteration. In the simplest case, this velocity and position updates are

$$\mathbf{Vp = \mathit{w}Vp + U(0;\ \varphi 1) \otimes (pBest - Xp) + U(0;\ \varphi 2) \otimes (gBest - Xp)} \quad \text{...(2.1)}$$

$$\mathbf{Xp = Xp + Vp} \quad \text{...(2.2)}$$

Where each operator is performed component-wise over each variable in the vector and $U(0; \varphi 1)$ and $U(0; \varphi 2)$ are uniformly distributed random numbers between 0 and $\varphi 1$ and 0 and $\varphi 2$. The vectors **pBest** and **gBest** represent, respectively, the best position in the search space this particle has ever seen, and the best position in the search space any particle in the swarm has ever seen. This has the effect of pulling the particle in three directions: the direction it was previously going, the direction of its personal best, and the direction of the global best. By tuning $\{w, \varphi 1, \varphi 2\}$, the user may control the relative effects of these three terms known as inertia, the cognitive component, and the social component to tune the particle's behavior.

This updated velocity is added to the particle's position vector at the current iteration, moving the particle through the search space. One limitation to this algorithm is that it assumes continuous state variables. If solution variables must take on discrete values, this representation is no longer appropriate[47] .

2.4.2 Discrete PSO Algorithm

Discrete PSO algorithm is applied to discrete and combinatorial optimization problems over discrete valued search space. In this algorithm, particle's positions are discrete values. The velocity and position equation are developed for real values and updated in each iteration. Discrete PSO has a high success rate in solving integer programming problems as compare with other methods, such as branch-and-bound fail. It has a quick convergence and better performance results[48].

Discrete Optimization A class of problems where an objective function is to be optimized that has variables whose values are limited to finite sets, numerical or categorical, ordered or unordered.

Discrete optimization problems, such as feature selection or inference in Bayesian networks, represent an important and challenging set of problems. These differ from continuous problems in that each variable can take on only a finite number of states [49]. An example is integer problems, where variables are restricted to a set of integer values. For such problems, there exists a relationship between neighboring values. More generally, there is an implicit ordering in the integers, integers with a larger difference between them are considered to be further apart. While integer problems are a subset of discrete problems, there are other types. For example, in abductive inference for Bayesian networks, the goal is to find the set of states that best explains a set of observations. Here, there may not exist a direct relationship or gradient between neighboring states[48].

While these states may be represented with integers during optimization, there is no real ordered relationship between the values of this *encoding*. We refer to such problems as categorical optimization problems.

2.4.2.1 Discretized strategies

PSO algorithm for solving discrete combinatorial optimization problem, the formation of two completely different technologies [50]:

1- Based on the classical continuous particle swarm optimization for specific issues, the discrete problem space is mapped to a continuous particle motion in space.

With appropriate changes of the PSO algorithm can solve a position retained in the calculation of the speed of the classical particle swarm optimization updated rules in continuous operation.

2- Another method for discrete optimization problems, based on the nature of mechanism of the PSO algorithm. Updated the basic idea of the classical particle swarm optimization algorithm framework to redefine the unique particle group discrete with operating and the operator. Unique in the calculation of discrete space to replace the traditional vector in the vector operating mechanism. From the point view of information flow, the PSO algorithm remains specific information exchange and flow mechanism.

2.2.3 Discrete Variations of PSO

In this section, review other approaches to discrete particle swarm optimization in this following explain [48].

1- **Integer PSO:** It is possible to use the original continuous PSO to solve problems with integer-valued solutions by rounding the particle's position at each iteration . This will refer to this algorithm as Integer PSO (IPSO). IPSO requires a relationship between neighboring states, as the velocity update equation uses subtraction to measure the distance between the particle's current position and the global and local best positions.

2- **Binary PSO:** Another discrete PSO algorithm is Binary PSO (BPSO). BPSO requires that the position vector be a binary representation of candidate solutions. This representation also changes the velocity interpretation: the velocity represents the probability of each variable assuming the value 0 or 1.

3- **Veeramachaneni PSO**: developed an extension to binary PSO that relaxes the need for a binary representation of the problem . VPSO, each variable is allowed to assume any of M discrete values. While the velocity update remains unchanged from the binary case, the position update is modified to allow for more than 2 states. After the velocity has been updated, it is mapped into the [0; M − 1] interval by first using a generalized version of the sigmoid function.

4-Pugh PSO: The multi-valued PSO extension most similar to ours was introduced by Pugh and Martinoli . We will refer to this variant as PPSO. PPSO, like ICPSO, uses a probabilistic interpretation of a particle and evaluates fitness stochastically by generating a sample solution.The position vector, however, does not represent a valid probability distribution explicitly in PPSO.

5-Angle Modulated PSO: also known as AMPSO, reduces a high-dimensional binary search space into a smaller continuous search space using an angle modulation-based method, thus reducing the number of parameters to be optimized . This speeds up optimization while potentially improving performance. The approach uses the angle modulation equation, which is given as the novelty of AMPSO is more related to the transformation of the search space than the PSO implementation itself. Additionally, this approach requires a binary representation of the problem, which has similar limitations to BPSO.

2.5.3.2 Integer and Categorical PSO (ICPSO)

ICPSO is a new discrete particle swarm optimization algorithm that is designed to handle both integer and categorical state variables. This is achieved by representing the particle's position as a set of probability distributions, one per variable, over the possible solution values. Solution values are produced by sampling from these distributions.

ICPSO has been shown to perform well compared to other discrete PSO variants, particularly on problems where there is no natural ordering to solution values[50].

ICPSO was developed to address a major pitfall of PSO the original PSO algorithm cannot handle discrete problems, and the existing discrete PSO variants were not appropriate for truly categorical problems because their update equations semantically require a numerical relationship or gradient between the states of the variables.

To overcome this limitation, ICPSO represents a particle's position not as a solution itself, but as a set of probability distributions over possible solution values. For a particle **p**, its position can be represented as **x***p* = [*Dp*,1*; D*,2*……; Dp,n*] where each *Dp,i* denotes the probability distribution for variable *xi*. Each entry in the particle's position vector is itself comprised of a set of distributions *Dp,i* = $[d^a_{p,i}, d^b_{p,i}, \ldots, d^k_{p,i}]$, where *dj p;i* corresponds to the probability that variable *xi* takes on value *j* for particle **p**. This allows the same velocity update equation to be used as in traditional PSO, though the interpretation changes: the update is now an adjustment to the particle's probability distributions. With this representation, a particle's fitness is

evaluated by sampling from this distribution and then calculating the fitness of that sample. Multiple samples may be drawn at each iteration to give a better idea of average fitness [51].

When a sample **S** is found that beats the local or global best, the best is updated and the distribution is biased toward producing similar samples in the future by updating the entries in the position vector as follows:

$$d^j_{gB,i} = \begin{cases} \epsilon \times d^j_{p,i} & \text{if } j \neq s_{p,i} \\ d^j_{p,i} + \sum_{\substack{k \in Vals(X_i) \\ \wedge k \neq j}} (1-\epsilon) \times d^k_{p,i} & \text{if } j = s_{p,i}. \end{cases}$$

This has the effect of biasing the particle toward producing samples similar to **S** in the future, while also automatically maintaining a valid probability distribution. As with regular PSO, the global best solution – in this case, the best sample, which was generated by the distributions from the last **gBest** particle found – is returned at the end of the optimization [52].

A-Advantages ICPSO Algorithm

As the following [49].

1-Can be simple to implement

1- Have few parameters to adjust

3-Able to run parallel computation

4- Can be robust and have higher probability and efficiency in finding the global optima

5- Can converge fast and do not overlap and mutate

6- Have short computational time can be efficient for solving problems presenting difficulty to find accurate mathematical models.

B-Disadvantages ICPSO Algorithm

As the following [49].

1- Can be difficult to define initial design parameters

2- Cannot work out the problems of scattering

2- Can converge prematurely and be trapped into a local minimum especially with complex problems.

C- Applications of ICPSO Algorithm

As the following **[**52].

1-Traveling salesman problem

2-Multiple knapsack problem

3-Vehicle routing problem

4-Carpool service problem

5-Task scheduling on heterogeneous

6-embedded systems

7-Mobile app recommendation

8-Query plan generation

9-Software project planning

10-Covering array generation

Chapter Three
The proposed System

Chapter Three

The Proposed System

3.1 Introduction

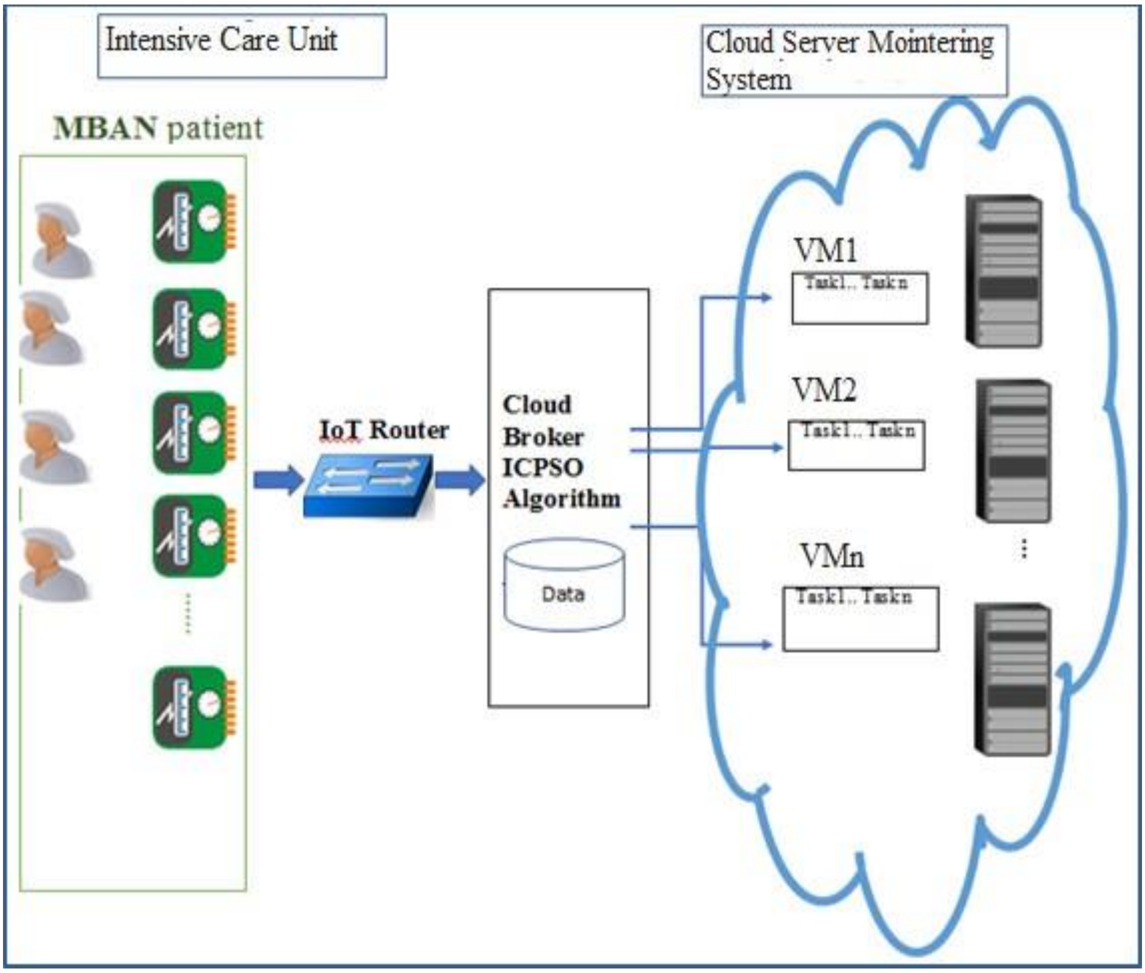
This chapter is concerned with the implementation requirements, design considerations, and the steps taken from the establishment of the proposed system. It consists of the layout description of the proposed system as well as the implementation details of each stage that is related to the proposed system. The proposed system cloud IoT for health system which implement using the new version PSO (ICPSO) algorithm is finding position optimal server(VM) minimum response time this is because the particle represents distribution instead of candidate solution for medical body area network (MBAN) by leveraging on IoT and cloud computing service providing health system services . However, the proposed system has some significant and potential stages such as to get data from sensors analysis stage, sent data to the cloud server, update service quality table and monitoring patient less time response.

3.2 The proposed Cloud -IoT for Intensive Care Unit Health system

The proposed system depends on the medical body of the area networks, the wearable devices (Caretaker) in the central care unit, and cloud computing using an important feature, so the mediator system stores and schedules the various tasks that represent the physiological medical signals of the patient, and that the scheduling problem is solved using new

version the algorithm PSO discret type (ICPSO), which assesses the effectiveness and efficiency of the proposed algorithm in terms of cost of tasks in the least time of implementation consists of four main components: **(**Intensive Care Unit UCI (MBAN, patient), IoT Router, cloud blocker, cloud server monitoring system) and monitoring system on line.

The proposed system is show in figure (3.1).



Figure(3.1): The proposed Could -IoT for Intensive care unit Health system.

The description of each step at the figure (3.1) is given below:

3.2.1 ICU

This is the first step1 in figure (3.1) Which are of patient care, wearable medical body space networks, and patient monitor screen.

1- **patient care**: Each patient connected to the wearable device that is equipped with wireless networks works to converge data that represents medical physiological signals the patient in the central care unit.

2- Medical Body Area Network Device(MBAN)

This is generated data from a sensor device system for people working in a medical environment. the requirement is that the sensors device be unobtrusive to the patient as possible the hardware sensors used must be small and wireless. By meeting the latter requirement, more reflective and natural values of the measured bodily parameters will be acquired; any chance of hindrance to the data collection is reduced significantly. Further, as the sensor devices are wireless, adequate battery life must be ensured to guarantee continuous and reliable monitoring without interruption. Potential hardware design of the sensors is a health monitoring as a caretaker device that is capable of measuring an array of physiological measures. An ‘all-in-one’ device such as this is ideal to eliminate any variability in the readings from the sensors that transform using technology Bluetooth using computers and mobile phones will be used to extract accelerometer data.

3.2.2 IoT Router

This is step 2 in figure (3.2), The router provides a wireless connection. Send and receive information through the health application, which sends data to the system center, storage and scheduling tasks, providing health services to the patient in the least time of implementation.

3.2.3 Cloud Broker

This is step 3 in figure (3.3), in this step cloud broker is creates the intermediate layer between the "IoT" router and cloud service providers where the patient can obtain all of the healthcare services.
Cloud broker consists of three types service.

a) **The Data Receiver**: A personal server which receives data using wireless communications. The role of the receiver is to also store previous readings from the sensors into the medical server.
b) **The Data Aggregator**: An aggregator which collates data from the various sensors in the patient module. It should be noted that before the aggregation of data occurs, the raw data must be processed to obtain only the necessary value.
c) **The Data Analyser**: An analyser which provides advantageous meaning to the data values. It applies the proposed ICPSO algorithm on the processed and aggregated data. Also responsible to receive data from IoT router and to send it to appropriate storage service in the monitoring system.

Cloud broker distribution of data patient to the cloud server (monitoring center) the proposed modified PSO algorithm (ICPSO) find best server depend on the probability of distribution tasks in the particle search space get the best solution reduces execution time task patient and service monitor.

3.2.3.1 The Implement ICPSO Algorithm for Cloud Broker scheduling

In this step, we implement the proposed algorithm that depends on the probability of distribution and that depends on scheduling tasks in finding the best virtual machine server that represents the particle location in finding solutions and the fitness function less time to implement.

The bird (particle) has the following information:

1- Pvelocity (t): Represents the new velocity of a particle.

2- Pvelocity (t-1): Represents its current velocity.

3- LBest Position : The best particle search space.

4- GBest Position: The best particle in neighbored search space.

5- Pposition (t): Represents the new position of a particle.

6- Pposition (t-1): Represents its current position.

7- r1 ,r2, r3 : Three random variables in the range [0, 1].

8- The constants C1 and C2 ,C3 represent the learning factors.

9- W: Inertia weight between (0.8 and 1.2).

10- The index-vector records the current position of the particle in the search space. Assume that there are N particles (VMs) in all the clouds. Each VM in the cloud(s) is considered a particle which represents a potential solution (VM) that can be allocated for executing the subtasks.

• *VM (data in network that sent from medical body area network)* the task scheduler by cloud broker.

Algorithm (3.1). ICPSO for Cloud Broker scheduling

Input : data MBAN sensor (systolic blood pressure, diastolic blood pressure, blood glucose , heartbeats rate)

Output: (Optimal best server (VM), optimal cost execution time best server (VM) with latency, optimal execution time no latency)

Begin :

Step 1: Initialization Step:

a. $\frac{}{\Sigma}$

b.

c. ( )

d.

Step 2: Initialize Weights.

Step 3: For MBAN requests X.

Step 4: For Iterations t Compute fitness function an optimal selection of best server for (VMs) by using the cloud broker scheduling attribute.

Step 5: Update velociy to the original equation in the second chapter in section (2.5), adding inertia weight, learning factors and random variables in this below equation (3.1).

= ( )

Step 6: Update Position to the original equation in the Chapter 2 in section (2.5) in this below equation (3.2).

Step 7: Update local calculated fitness function of each particle (VM) with its $L_{Best\ Position}$ as index($P_{position}$(1)), If the min (cost time) index ($P_{position}$ (t)) is better or equal than $L_{Best\ Position}$, then put the index ($P_{position}$ (t)) as $L_{Best\ Position}$ location.

Step8: End

Step 9: Update global values If the min(cost time) particle find index ($L_{Best\ position}$ (t)) is better or equal than $G_{Best\ Position}$, then reconstruct $G_{Best\ Position}$ to the current index in particle array.

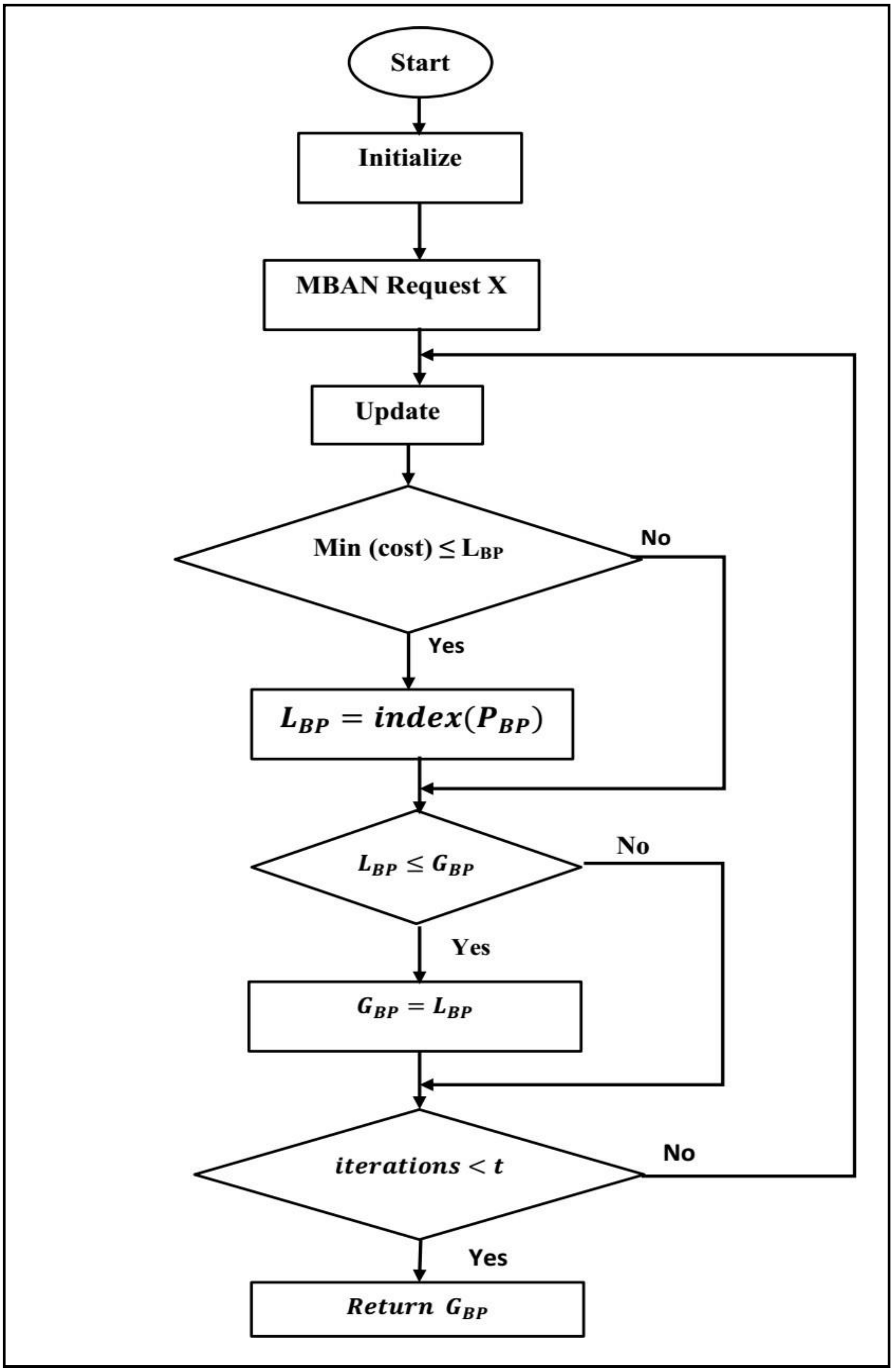
Step10: End

Step 11: End

Step 12 : Finish request

Step 13: Return

End



Flow chart (3.2): ICPSO Algorithm for cloud broker.

The fitness function attribute find the best server for (VM).

The proposed fitness function is composed of sevent essential attributes which are TT ,WT, CPU(U),execution speed time , physical latency, physical no latency, cost time.

The calculations of these attributes depend on three secondary attributes arrival time , completion time , barst time as follows:

1- Arrival Time (AT): The time at which the task arrives in the ready queue. Generate it random time N(VM) the task arrival time find in (VM) to the server. It is expressed as shown in equation (3.3).

AT = random(N) ....(3.3)

2- Completion Time (CT): The time at which the task completes its execution. It is expressed as shown in equation (3.4).

CT = AT+ (N) .... (3.4)

3- Turnaround Time (TT): Time difference between completion time and arrival time. It is expressed as shown in equation (3.5).

TT=CT-AT .... (3.5)

Average Turnaround Time (ATT): The turnaround time for each task (VM) on the sum of the turnaround total time N(VM). It is expressed as shown in equation (3.6).

$$\textbf{ATT} = \frac{TT}{\sum} \quad \text{..(3.6)}$$

4- Burst Time (BT): The time required by a task for CPU execution.

It is expressed as shown in equation (3.7).

BT = (TT- (N))/N...(3.7)

6-Waiting Time (WT): Time difference between turnaround time and burst time. It is expressed as shown in equation (3.8).

$$WT=TT-BT \quad \text{.....(3.8)}$$

Average Waiting Time (AWT): The wait time for each task (VM) on the sum of the total waiting time N(VM). It is expressed as shown in equation (3.9).

$$A.WT = \frac{WT}{\sum} \quad \text{......(3.9)}$$

6- CPU Utilization (U): The percentage of CPU capacity used during specific period of time. It is expressed as shown in equation (3.10).

U=100% - (%time spent in the idle task) .....(3.10)

Average CPU Utilization (ACPU(U)): The percentage of CPU capacity used during specific period of time for each task (VM) on the sum of the the percentage of CPU capacity N(VM). It is expressed as shown in equation (3.11).

$$A.\ CPU(U) = \frac{U}{\sum} \quad \text{......(3.11)}$$

This section presents the formulas for calculating the three important attributes essential using the formerly aforesaid attributes to find the best server of (VM) as follows:

7- **Execution Speed Time:** Attribute is the speed of server execution task execution speed depends on doubling the processor usage speed. It is expressed as shown in equation (3.12).

Execution Speed time = (2*U - TT+WT)............................(3.12)

8- Physical Latency : The time it takes for some task (VM) to get to its destination across the network. Generated random N(VM) available in the network it is expressed as shown in equation (3.13).

Physical Latency =random (N)..(3.13)

- Physical no latency of each task (VM) in the network is fixed physical no latency assume its value is one. It is expressed as shown in equation (3.14).

  Physical No Latency = one (N) .... (3.14)

9- Cost Time: The total execution time for each task (VM) in the server depend on a factor physical latency end execution speed time. It is expressed as shown in equation (3.15).

$$\textbf{Cost Time} = \frac{\textbf{Physical Latency}}{\textbf{Execution Speed Time}} \qquad \text{......(3.15)}$$

- Calculate the cost time when the network physical latency is fixed. It is expressed as shown in equation (3.16).

$$\textbf{Cost Time} = \frac{\textbf{Physical no Latency}}{\textbf{Execution Speed Time}} \qquad \text{......(3.16)}$$

3.2.4 Cloud Server Monitoring System

In this section, we describe an improved patient monitoring system through the establishment of an automatic medical data gathering system in real-time and analysis in order to assist clinicians in decision making in ICUs. For this, we propose a system with architecture in three layers that are: In this step of figure (3.4) is responsible for determining the best services that it uses to find the optimal server (VM) in cloud to enhance the task scheduling process which leads to reduce total time of patient service and maximize utilization of resources. The control center is connected to 10 servers the probability of each server connected.

The monitoring system operates on a flag function that compares with each patient signal before it is stored. Using automated monitoring software compared with threshold value knowing the patient's condition if patient is in a dangerous condition based on the patient's body biomarkers the data that is analyzed in the database shows each alert server with patient information.

A flag is a predefined bit or bit sequence that holds a binary value program that uses a flag to remember something or to leave a sign for another program. In a message being exchanged by two cloud broker and server monitoring system , a three-bit flag's field or data area might be set to one of three configurations. Scheme Program Automated monitoring connected to each server working to show the message informing patient data analysis of this data in the database computing intermediary based on the vital signal diastolic blood pressure and contraction. If any flag notification, blood press flag or blood glucose flag or heart rate flag is on, then set the alert message. Otherwise, everything is normal in the sign physiological.

Algorithm (3.2). Flag Blood Pressure

Input : data set blood pressure (SBP , DBP)

Output: Set Blood Pressure Flag

Begin

Step1: Comparing the value of each patient blood pressure in the data set (SBP < 90) OR (DBP < 80), then get only the values smaller than the mean value get message alert flag 'Low blood pressure' , other wise Blood Pressure Flag = 0, go to Step4 .

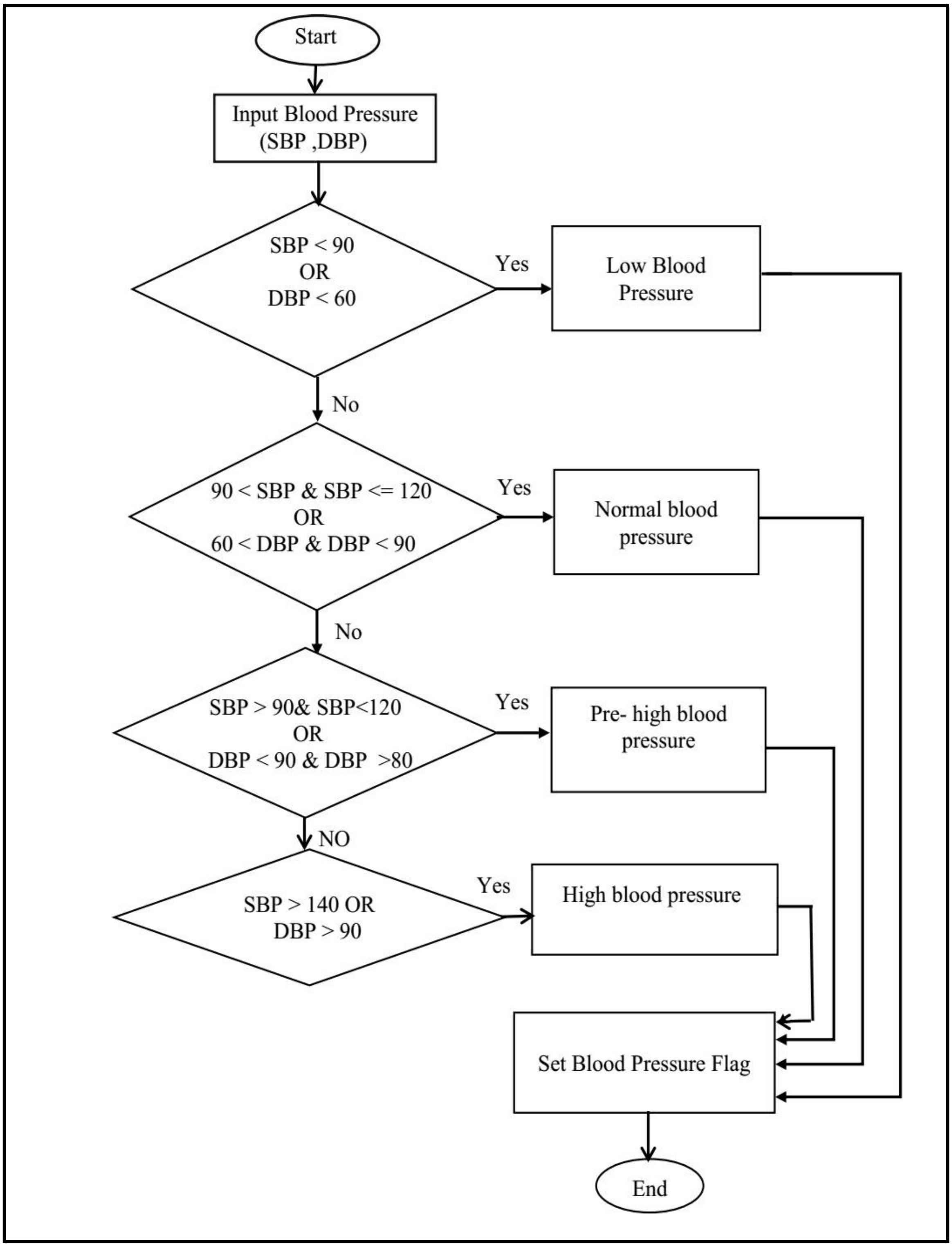
Step 2: Comparing the value of each patients blood pressure in the data set (SBP > 90 & SBP <= 120)OR (DBP > 60 & DBP <= 80), then get only the values larger and smaller than the mean value get message alert Flag 'Normal blood pressure', other wise Blood Pressure Flag = 1, go to step3.

Step 4: Comparing the value of each patients blood pressure in the data set (SBP > 120 & SBP < 140)OR (DBP > 80 & DBP < 90), then get only the values medium than the mean value get message alert Flag 'Pre-high blood , other wise Blood Pressure Flag = 1, go to Step 5.

Step 5: Comparing the value of each patients blood pressure in the data set (SBP > 140 & DBP >90), then get only the values larger than the mean value go to Step 8.

Step 6: Get Blood Pressure Flag 'High blood pressure'.

End



Flow chart (3.3): Flag Blood Pressure MBAN-Cloud Monitoring System.

Algorithm (3.3). Flag Blood Glucose Level

Input : Data Set Blood Glucose Level

Output: Set Blood Glucose Level Flag

Begin

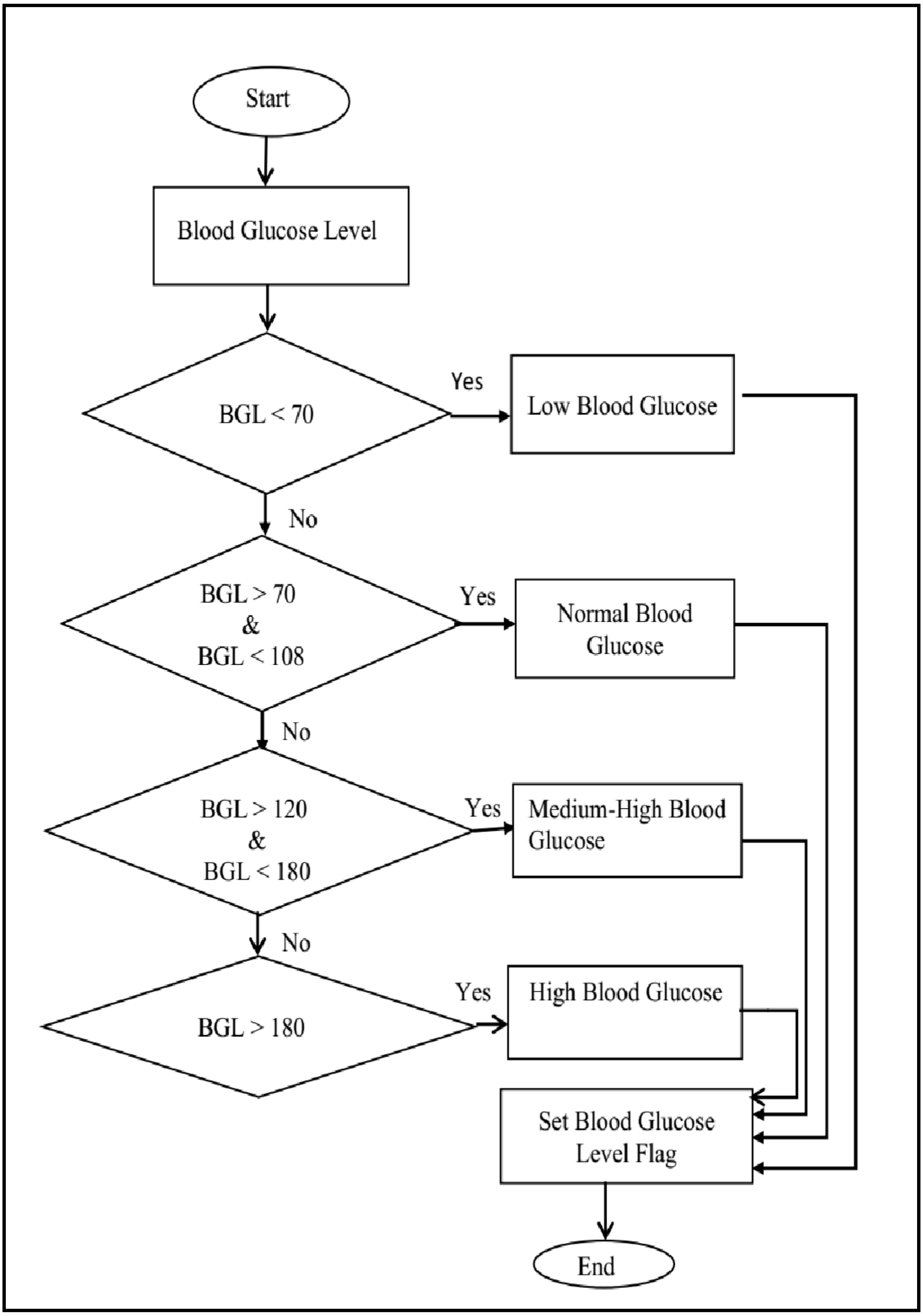
Step1: Comparing the value of each patient blood glucose level in the data set (BGL < 70), then get only the values smaller than the mean value go message alert flag 'Low Blood Pressure', other wise blood glucose level flag = 1, go to Step2.

Step 2: Comparing the value of each patients blood glucose level in the data set (BGL >= 70 & BGL < 180), then get only the values larger and smaller than the mean value go message alert blood glucose level flag=0 ' Normal Blood Glucose Level', other wise blood glucose level flag = 1, go to step3 .

Step 3: Comparing the value of each patients blood glucose level in the data set (BGL > 120 & BGL < 180), then get only the values medium than the mean value go blood glucose level flag=1 'Pre-high blood glucose level'.
, other wise blood glucose level flag = 1, go to step 4.

Step 4: Comparing the value of each patients blood glucose in the data set (BGL > 180), then get only the values larger than the mean value get massage alert blood glucose level flag 'High Blood Glucose Level'.

End



Flow chart (3.4): Flag Blood Glucose Level MBAN-Cloud Monitoring System.

Algorithm (3.4). Flag Heart Beat Rate

Input : Data Set Heart Beat Rate

Output: Set Heart Beat Rate Flag

Begin

Step1: Comparing the value of each patient heart beat rate in the data set (HBR < 75), then get only the values smaller than the mean value go to step 2, other wise Low heart beat rate flag = 0, go to Step3 .

Step 2: Get pressure flag 'Low heart beat rate '.

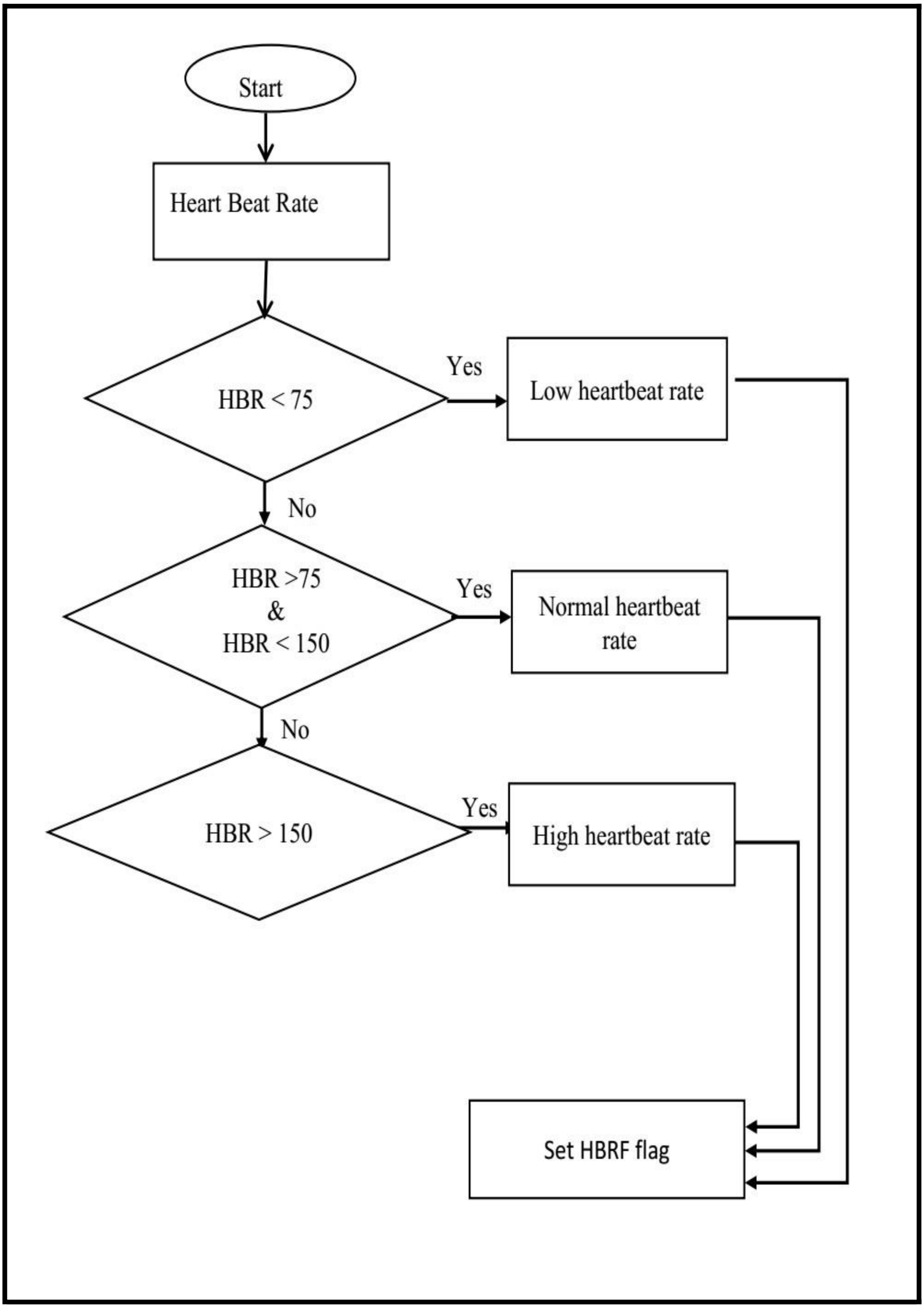
Step 3: Comparing the value of each patients heart beat rate in the data set (HBR >75 & HBR < 150), then get only the values larger and smaller than the mean value go to Step 4, other wise heart beat rate flag = 0, go to step5.

Step4: Get heart beat rate flag ' Normal heart beat rate'.

Step 5: Comparing the value of each patients heart beat rate in the data set (HBR > 150), then get only the values large than the mean value go to step6.

Step 6: Get heart beat rate flag ' High heart beat rate".

End



Flow chart (3.5): Flag Hear Beat Rate MBAN-Cloud Monitoring System.

3.3 Performance Algorithm

In this section, explain the equations that the proposed system relies on evaluating the performance of the algorithm that explain as follows:

1-**Average Execution Time**: Speed time performs each task (VM) on the total speed time of all tasks (VM). Average execution time with physical latency and average execution time with physical no latency, it is expressed as shown in equation (3.17),(3.18).

$$\textbf{Average Execution Time Physical Latency} = \left(\frac{\textbf{Cost Time best(vm) in number trails}}{\sum_n \textbf{Cost Time in trails}} \right) / 10 \quad .....(3.17)$$

$$\textbf{Average Execution Time Physical no latency} = \left(\frac{\textbf{Cost Time}}{\sum} \right) / 10 \quad ......(3.18)$$

2- performance: Is clarified as the percentage of speed up by k processors. Efficiency with physical latency and efficiency with physical no latency, it is expressed as shown in equation (3.19),(3.20).

$$\textbf{Performance efficiency} = \left(100 * \frac{(\textbf{Average Execution Time latency})}{\sum (\textbf{Average Execution Time Latency})} \right) / N \quad .....(3.19)$$

$$\textbf{Performance efficiency} = \left(100 * \frac{(\text{Average Execution Time No latency})}{\sum(\text{Average Execution Time No Latency})}\right) / N \quad \ldots(3.20)$$

Performance Ratio Rate: Sum efficiency execution time with physical latency or physical no latency divided on the number of servers. It is expressed as shown in equation (3.21),(3.22).

$$\textbf{Performance Ratio Rate} = \frac{\sum \text{Efficiency Physical Latency}}{N} \quad \ldots (3.21)$$

$$\textbf{Performance Ratio Rate} = \frac{\sum}{N} \ldots\ldots(3.22)$$

Example 1 : Physical Latency measurement using command ping or tracer Check for communication with network devices or any website by knowing the name of the site or IP.

ping 192.168.1.102.

Latency is fixed not variable has no effect in algorithm.

Reply unreachable

Example 2: ping www.translate.google .com.

Latency is variable and affect the algorithm it equal 1 second.

Replay sent and recive .

Latency minimum = 84ms , maximum= 88 ms ,average = 86 ms.

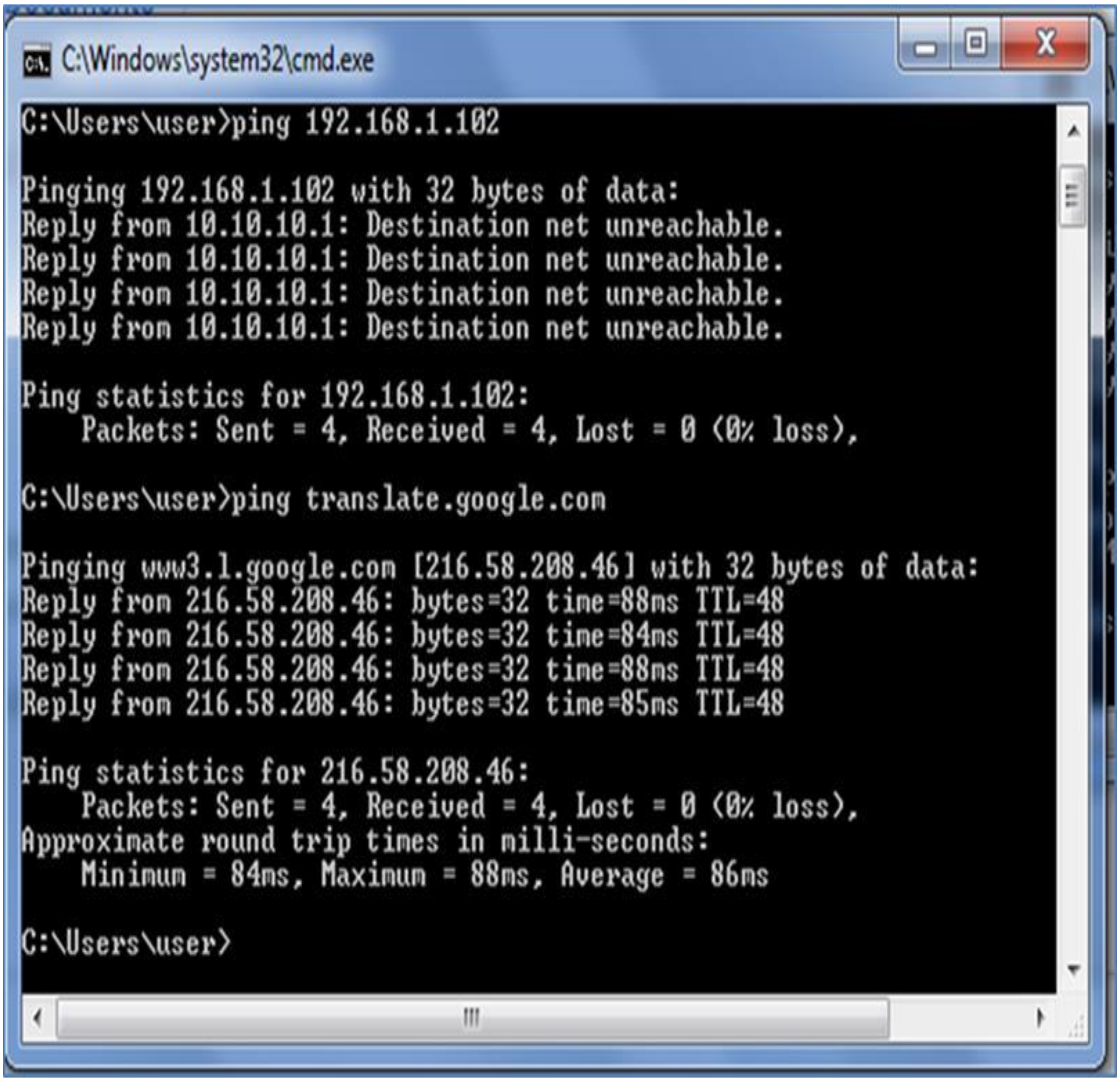


Figure (3.2): Example illustrating latency test in network and physical no latency using ping.

Chapter Four

The Experimental Results and Evaluation

Chapter Four
Experimental Results and Evaluation

4.1. Introduction

In this chapter summarize the implementation results obtained by the suggested system described in detail in chapter three. The experimental results and evaluation of the system phases will be explained in addition to a comparison process with other existing systems. In other words, this chapter is the performances evaluations of the proposed cloud IoT for HCS system model using proposed algorithms ICPSO. It will contain a detailed depiction of the steps involved in application implementation. Throughout the implementation and testing, the proposed system is implemented by using Matlab2018 a is used as programming language for implementation of the proposed system. The experiments were performed on an Intel (R) Core (TM) i3 CPU M 380 @ 2.53 GHz , 32 bit Operating System and 4GB RAM.

4.2 Data Sets

The data collected from the physiological signal using the smart sensors connected to the patient's body. These local data were collected from the ICU in the city hospital for eight weeks using a medical staff. The data was collected patients numbered 31 for a whole 24 hours measurements of physiological signal (Blood pressure, Blood Glucose level, Heart Rate).

4.3. The proposed System Implementation

This system has four stages executed sequentially, starts by MBAN for patient and ends with the cloud server , as described in the following sections.

4.3.1 MBAN

At this first stage, the implementation of the proposed system is simulated reading data MBAN by pressing the command button to start read real data for patients from a file (dataset.xlsx). Microsoft Office Excel 2010 program. This shows four sensors all in one wearable device continuously take measurements of the patient who are wearing the MBAN device.

It consisted of four patient vital physiological values from IoT MBAN sensor measurement (Systolic blood pressure, Diastolic blood pressure, Glucose Level, Heartbeats Rate). Figure(4.1), illustrates IoT MBAN measurements sign vital physiological for patients continues.

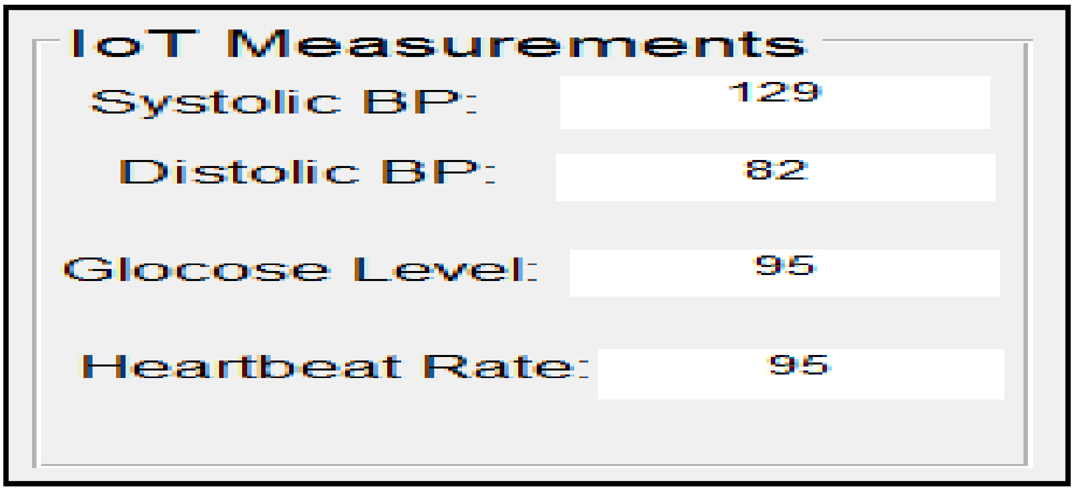


Figure (4.1): Illustrate IoT MBAN Measurements Sign Vital Physiological in Interface Matlab.

4.3.2. IoT Router

In this stage**,** the router in a network device that routes traffic send patient medical information across wireless networks to the cloud broker database which contains patient data collection and sending to health care system servers.

4.3.3 Cloud Broker

In this stage, cloud broker acts as a mediator who is responsible for sending and scheduling task (VM) by using new another PSO is ICPSO algorithm.

4.3.3.1 The Implantation ICPSO Algorithm by Cloud broker

To evaluate the performance of algorithm these are described in subsection (3.2.3). The proposed fitness function is composed of nine attributes find the best server for (VM) in search space.

Table (4.1): ICPSO parameters

NO	Parameters	Values
1	VM min- VM max	100-1000
2	C_1, C_2, C_3,as acceleration coefficients	2
3	W as inertia weight	0.2 & 0.8
4	Number iteration	100
5	r_1,r_2,r_3 as random values	0&1

Step1: This section presents calculate fitness function attributes, table (4.2) shows the results sample of attributes for each task (VM) that scheduling for cloud server the first attribute (AT) by using equation (3.3), generate it random time for (VM), attribute (CT) calculate by using equation (3.4), attribute (TT) calculate by using equation (3.5), attribute (BT) calculate by using equation (3.6), attribute (WT) calculate by using equation (3.9).calculate (U) attribute by using equation (3.10).

Table (4.2): Result from sample basic attributes of the scheduling of tasks (VM) by using the ICPSO algorithm on cloud broker.

N	AT	CT	TT	BT	WT	U
1	797	1368	571	0.325	570.675	9533
2	362	633	271	0.689	270.311	6490
3	431	810	379	0.588	378.412	10501
4	133	959	826	0.199	825.801	4489
5	635	1548	913	0.836	912.164	5656
6	10	616	606	0.307	605.693	4051
7	398	471	73	0.849	72.151	7771
8	810	1682	872	0.05	871.95	2027
9	617	963	346	0.096	345.904	3988
10	589	607	18	0.915	17.085	5498
11	469	820	351	0.281	350.719	1172
12	57	764	707	0.177	706.823	3882
13	536	1398	862	0.438	861.562	9779
14	622	625	3	0.978	2.022	2591
15	725	853	128	0.059	127.941	7475
16	818	1612	794	0.201	793.799	6243
17	66	514	448	0.038	447.962	5297
18	989	1253	264	0.251	263.749	4444
19	614	1593	979	0.962	978.038	5909
20	302	1157	855	0.583	854.417	10852
21	36	724	688	0.343	687.657	1189
22	100	353	253	0.069	252.931	10442
23	315	1085	770	0.129	769.871	3958
24	45	771	726	0.201	725.799	1796
25	162	625	463	0.455	462.545	1822

26	110	949	839	0.227	4322	838.773
27	239	607	368	0.04	5854	367.96
28	379	442	63	0.36	8996	62.64
29	221	865	644	0.221	4443	643.779
30	679	933	254	0.236	1428	253.764
31	569	1343	774	0.022	2437	773.978
32	649	1591	942	0.21	512	941.79
33	448	1300	852	0.139	5523	851.861
34	926	1554	628	0.598	6777	627.402
35	914	1319	405	0.361	5594	404.639
36	984	1747	763	0.135	7302	762.865
37	919	1580	661	0.612	1735	660.388
38	606	880	274	0.208	2479	273.792
39	590	749	159	0.004	10253	158.996
40	40	354	314	0.405	9228	313.595
41	78	134	56	0.682	7866	55.318
42	580	1038	458	0.062	9393	457.938
43	710	1561	851	0.578	6121	850.422
44	856	1635	779	0.635	8601	778.365
45	807	1200	393	0.065	3910	392.935
46	699	1295	596	0.518	5633	595.482
47	135	536	401	0.219	2587	400.781
48	903	1364	461	0.152	2798	460.848
49	522	692	170	0.172	1595	169.828
50	943	954	11	0.454	2249	10.546
51	473	1283	810	0.331	10622	809.669
52	780	1387	607	0.187	2282	606.813
53	5	475	470	0.36	6518	469.64
54	685	1360	675	0.49	10250	674.51
55	974	1565	591	0.113	4367	590.887
56	124	636	512	0.199	4474	511.801
57	696	1162	466	0.198	8864	465.802
58	4	911	907	0.166	8077	906.834

59	996	1472	476	0.306	9657	475.694
60	308	935	627	0.188	479	626.812
61	176	292	116	0.668	9593	115.332
62	19	977	958	0.342	3215	957.658
63	683	1324	641	0.352	7776	640.648
64	659	1034	375	0.23	4330	374.77
65	413	701	288	0.253	7116	287.747
66	689	1577	888	0.692	9889	887.308
67	618	930	312	0.364	5111	311.636
68	474	721	247	0.147	4250	246.853
69	322	685	363	0.126	6707	362.874
70	756	1237	481	0.055	5817	480.945
71	28	173	145	0.292	7882	144.708
72	827	1772	945	0.139	8516	944.861
73	878	1170	292	0.051	7298	291.949
74	75	385	310	0.269	7410	309.731
75	265	1238	973	0.103	10143	972.897
76	305	715	410	0.293	1388	409.707
77	532	1325	793	0.735	5426	792.265
78	544	1072	528	0.154	1110	527.846
79	776	1034	258	0.577	1547	257.423
80	597	1210	613	0.298	8151	612.702
81	64	373	309	0.617	8441	308.383
82	373	800	427	0.386	5757	426.614
83	451	557	106	0.202	7919	105.798
84	194	585	391	0.223	9309	390.777
85	579	1442	863	0.261	7106	862.739
86	140	228	88	0.829	5630	87.171
87	761	1591	830	0.59	1267	829.41
88	575	1350	775	0.649	2475	774.351
89	47	374	327	0.13	8699	326.87
90	927	1618	691	0.584	4129	690.416
91	154	900	746	0.201	4396	745.799
92	633	1232	599	0.374	4757	598.626
93	726	1150	424	0.264	9286	423.736
94	348	1301	953	0.854	7484	952.146
95	917	1765	848	0.237	4760	847.763
96	995	1001	6	0.538	5983	5.462
97	185	734	549	0.451	7456	548.549
98	795	1254	459	0.254	8966	458.746
99	729	1238	509	0.145	5199	508.855
100	174	681	507	0.013	9861	506.987

Step2: Calculate execution speed time attribute by using equation (3.12), calculate the physical latency attribute of each task(VM) in the network is variable by using equation (3.13), calculate cost time by using equation(3.15). The essential attribute from speed time and physical latency from the results sample are illustrated in a table (4.2).

Table (4.3): Result from sample essential attribute of the scheduling of tasks (VM) by using the ICPSO algorithm on cloud broker.

N	Execution Speed Time	Physical Latency	Cost Time
1	1.9065675	923	0.048411609
2	1.2979311	918	0.070727945
3	2.1001412	606	0.028855203
4	8.977801	35	0.003898505
5	1.1311164	473	0.041817093
6	8.101693	966	0.119234338
7	1.5541151	153	0.009844831
8	4.05395	139	0.034287547
9	7.975904	636	0.079740177
10	1.0995085	806	0.073305481
11	2.343719	842	0.359258085
12	7.763823	743	0.095700275
13	1.9557562	987	0.050466413
14	5.181.022	165	0.031846999
15	1.4949941	787	0.052642348
16	1.2485799	684	0.054782237
17	1.0593962	719	0.067868848
18	8.887749	584	0.065708426
19	1.1817038	383	0.032410829
20	2.1703417	21	0.00096759
21	2.377.657	999	0.420161529
22	2.0883.931	556	0.02662334
23	7.915.871	666	0.084134772
24	3.591.799	394	0.109694334
25	3.643.545	855	0.234661573

26	8.643.773	481	0.055646996
27	1.1707.96	294	0.025111121
28	1.7991.64	212	0.01178325
29	8.885.779	279	0.031398485
30	2.855.764	187	0.065481601
31	4.873.978	429	0.088018452
32	1.023.79	439	0.428798875
33	1.1045.861	351	0.031776608
34	1.3553.402	365	0.026930508
35	1.1187639	701	0.062658439
36	1.4603865	480	0.032868011
37	3.469388	323	0.093099993
38	4.957792	146	0.029448593
39	2.0505996	660	0.032185708
40	1.8455595	679	0.036791011
41	1.5731318	14	0.000889945
42	1.8785938	924	0.049185726
43	1.2241422	414	0.0338196
44	1.7201365	804	0.046740477
45	7.819935	292	0.037340464
46	1.1265482	3	0.0002663
47	5.173781	64	0.012370064
48	5.595.848	548	0.097929751
49	3.189828	515	0.161450711
50	4.497546	488	0.108503615
51	2.1243669	933	0.043918967
52	4.563813	468	0.102545832
53	1.303564	234	0.017950787
54	2.049951	179	0.008731916
55	8.733887	161	0.018433946
56	8.947801	184	0.020563712
57	1.7727802	997	0.056239347
58	1.6153.834	747	0.046242892
59	1.9313.694	541	0.028011213
60	9.57812	420	0.438499413

61	19.185332	883	0.046024744
62	6.429658	47	0.007309876
63	1.5551648	180	0.011574336
64	8.65977	698	0.080602603
65	1.4231747	259	0.01819875
66	1.9777308	760	0.038427879
67	1.0221636	96	0.009391843
68	8.499853	63	0.007411893
69	1.3413874	755	0.056285008
70	1.1633945	190	0.01633152
71	1.5763708	362	0.02296414
72	1.7031861	62	0.003640236
73	1.4595949	835	0.057207654
74	14819.731	220	0.014845074
75	2.0285897	888	0.043774254
76	2.775707	946	0.34081407
77	1.0851265	537	0.049487318
78	2.219846	592	0.266685166
79	3.093423	772	0.249561731
80	1.6301702	594	0.036437913
81	1.6881383	80	0.004738948
82	1.1513614	746	0.064792862
83	1.5837798	854	0.053921637
84	1.8617777	500	0.026856053
85	1.4211739	349	0.024557164
86	1.1259171	461	0.0409444
87	2.53341	487	0.192231025
88	4.949351	104	0.021012856
89	1.739787	734	0.042189073
90	8.257416	534	0.064669141
91	8.791799	381	0.043335841
92	9.513626	458	0.048141476
93	1.8571736	722	0.03887628
94	1.4967146	589	0.03935286
95	9.519763	778	0.081724724
96	1.1965462	947	0.079144458
97	1.4911549	176	0.011802932
98	1.7931746	258	0.014387891
99	1.0397855	208	0.020004126
100	1.9721987	502	0.025453825

Step3: Calculate (ATT) attribute by using equation (3.6), calculate (AWT) attribute by using equation (3.9), calculate (A.CPU(U)) attribute by using equation (3.11), explain in chapter three in subsection (3.2). depending on the result from sample secondary attributes of the scheduling of tasks (VM) in the table(4.2).

Table (4.4): Result from samples second attributes (ATT), (A.CPU(U)), (AWT) of the scheduling of tasks (VM) probability best server.

N	ATT	AWT	A.CPU (U)
1	0.14285623	0.686226419	1.339099664
2	0.185508403	0.56041585	1.551725773
3	0.205456825	0.363293777	1.480889206
4	0.052339365	0.335883983	0.871594975
5	0.022755726	0.265533998	1.935668474
6	0.124297282	0.167688009	0.628695163
7	0.034796552	0.307545123	0.623775609
8	0.159194188	0.180437037	0.432905232
9	0.064461604	0.194428173	0.464459044
10	0.143799305	0.163674355	0.384676678
11	0.027401429	0.139126615	0.674768753
12	0.041536416	0.122410237	0.373254247
13	0.027677737	0.122551913	0.351361753
14	0.031976294	0.117408287	0.45025793
15	0.097893119	0.127934023	0.175136421
16	0.02116363	0.105374736	0.244387392
17	0.00293774	0.114258151	0.279900864
18	0.011568364	0.063434776	0.261373886
19	0.032579057	0.095953911	0.256015988
20	0.008861918	0.096712989	0.372238072
21	0.010829551	0.073895834	0.275670679
22	0.009929531	0.070278401	0.229886272
23	0.018520733	0.083327594	0.300009219
24	0.00075917	0.080967209	0.289903422

25	0.008138	0.22842	0.060495
26	0.001695	0.252629	0.05097
27	0.011405	0.25707	0.09328
28	0.011018	0.200737	0.032886
29	0.015264	0.199571	0.060059
30	0.055698	0.152897	0.058944
31	0.000339	0.217334	0.048399
32	0.00213	0.297781	0.058132
33	0.002172	0.199761	0.042584
34	0.013129	0.191891	0.042546
35	0.000487	0.159748	0.049504
36	0.004266	0.255671	0.042766
37	0.002944	0.191619	0.046554
38	0.001259	0.193356	0.039947
39	0.001331	0.180587	0.048722
40	0.003871	0.18273	0.038381
41	0.0005	0.119207	0.032207
42	0.008099	0.213647	0.040112
43	0.002697	0.170732	0.040975
44	0.006349	0.167088	0.045088
45	0.005602	0.14094	0.041864
46	0.004174	0.160701	0.032529
47	0.003894	0.155332	0.035742
48	0.002661	0.151349	0.034901
49	0.004176	0.11462	0.03209
50	0.000789	0.143324	0.031316
51	0.002545	0.125285	0.03356
52	0.002241	0.117735	0.0267
53	0.001327	0.105149	0.023905
54	0.001496	0.137514	0.035355
55	0.000243	0.127996	0.028597
56	0.000246	0.14003	0.033329
57	0.001419	0.16285	0.030172
58	0.000734	0.095582	0.023578
59	0.001635	0.120481	0.033082
60	0.005108	0.107117	0.03341
61	0.001088	0.128051	0.02827
62	0.009264	0.104508	0.029227
63	0.003772	0.101892	0.019793

64	0.000236007	0.023796881	0.102432006
65	0.00216355	0.026780063	0.118736481
66	0.004515644	0.031064506	0.11357998
67	0.003797451	0.024550334	0.095806313
68	0.001854641	0.027639604	0.09725844
69	0.001119395	0.027596772	0.103392456
70	0.001856613	0.029681961	0.122897507
71	0.00367855	0.023403086	0.088793933
72	0.00571971	0.026463309	0.111190928
73	0.010154126	0.025358257	0.080738303
74	0.001375696	0.024675518	0.102047188
75	0.002548736	0.022513212	0.087789582
76	0.004994013	0.024431182	0.090360803
77	0.000584816	0.023424519	0.088348684
78	0.003048238	0.023669906	0.091406318
79	0.004806724	0.018822777	0.078177987
80	0.000639579	0.020161446	0.095364432
81	0.001399255	0.018836259	0.107738334
82	0.000890184	0.015926605	0.0756754
83	0.006885031	0.022454488	0.095901315
84	0.000828534	0.021831533	0.091408232
85	0.001087669	0.021788738	0.08212387
86	0.00340229	0.019691903	0.081397205
87	0.001857191	0.022847736	0.079530861
88	0.003500209	0.020757542	0.069018362
89	0.000328902	0.01464346	0.083751641
90	0.001982254	0.019394466	0.077054097
91	0.000297846	0.02002061	0.071172966
92	0.000462627	0.01932645	0.077976552
93	0.003224279	0.021042901	0.071271836
94	0.001021971	0.022657441	0.081049624
95	0.0074502	0.017902732	0.068710315
96	0.000481122	0.01877766	0.070365469
97	0.000971166	0.018046923	0.078403815
98	0.005386485	0.01878704	0.06178245
99	0.0044705	0.016703209	0.077217443
100	0.003431	0.023412	0.0045633

Figure (4.2) shows the inverse relationship between the number of(VM) and the average turnaround time of requests. Which means increasing the number of task (VM) in server reflects the decreasing in the turnaround time is described the average turnaround time in the table (4.4).Which is applied using the equation (3.6) in section (3.2) which means the proposed ICPSO algorithm leads to minimized (ATT) with increasing in number task (VM) server.

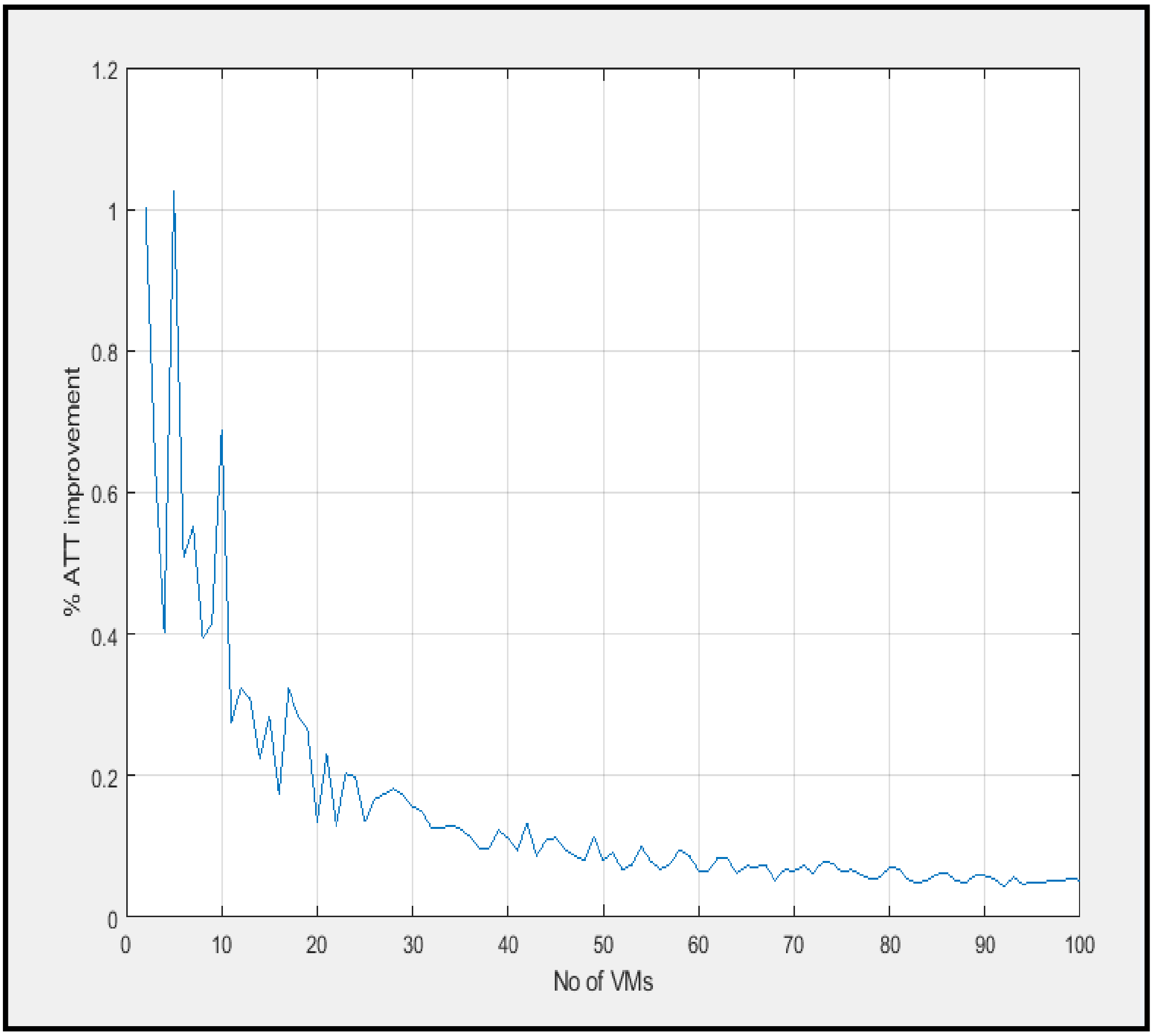


Figure (4.2): Illustrate the relationship between average (ATT) and number (VM) server using ICPSO algorithm**.**

Figure (4.3), shows there is an inverse relationship between the number of task (VM) server average wait time. Which is described the average wait time in the table (4.4), which is applied using the equation (3.9) in section (3.2), which means the proposed ICPSO algorithm leads to minimized time (AWT) with increasing in number of task (VM) server.

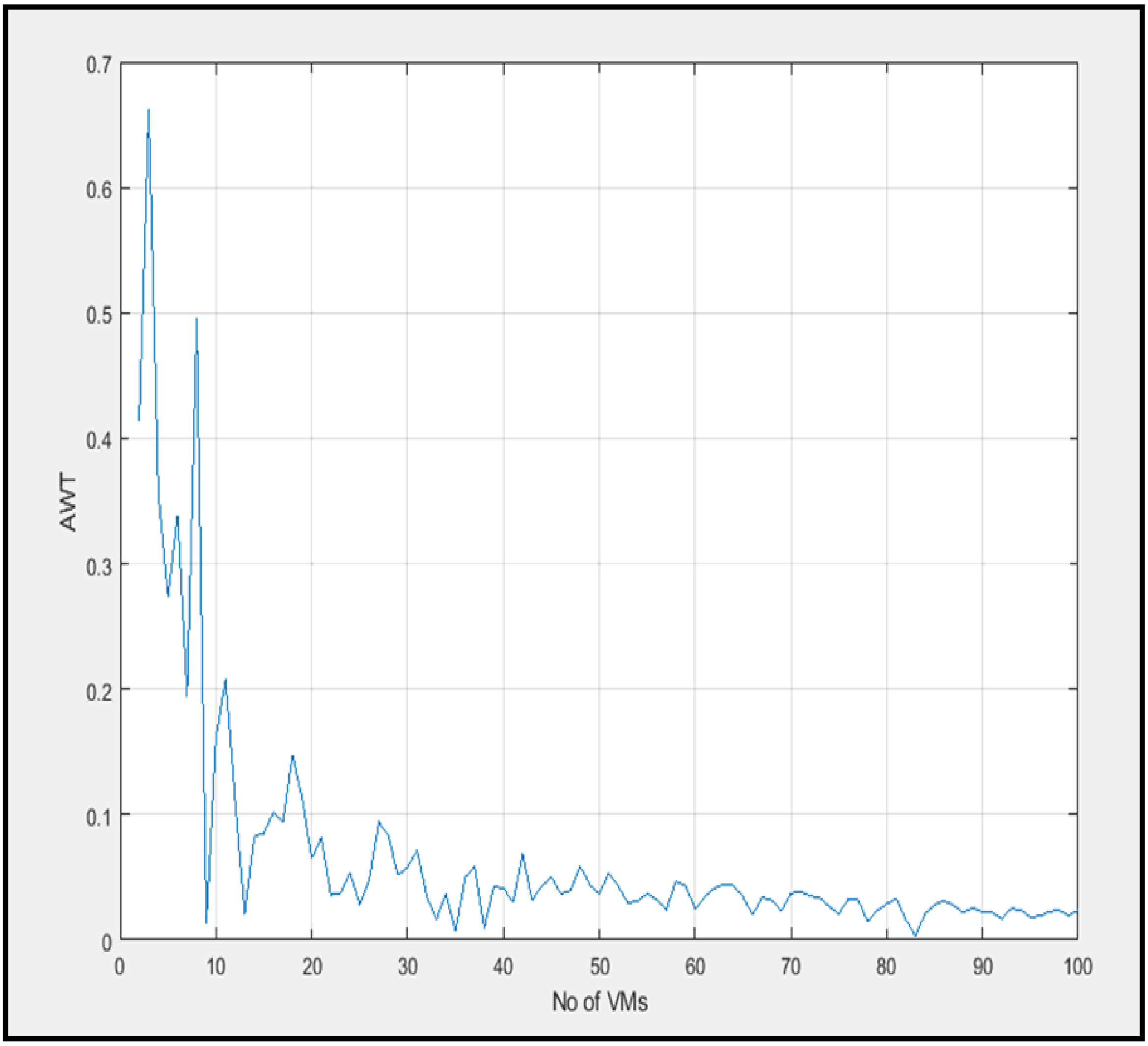


Figure (4.3): Illustrate The relationship between(AWT)and number (VM) server using ICPSO algorithm**.**

There is an inverse relationship between the number of (VM)and of CPU utilization .Which means increasing the number of resource utilization when the implemented on the lower number (VM) in server shown below .

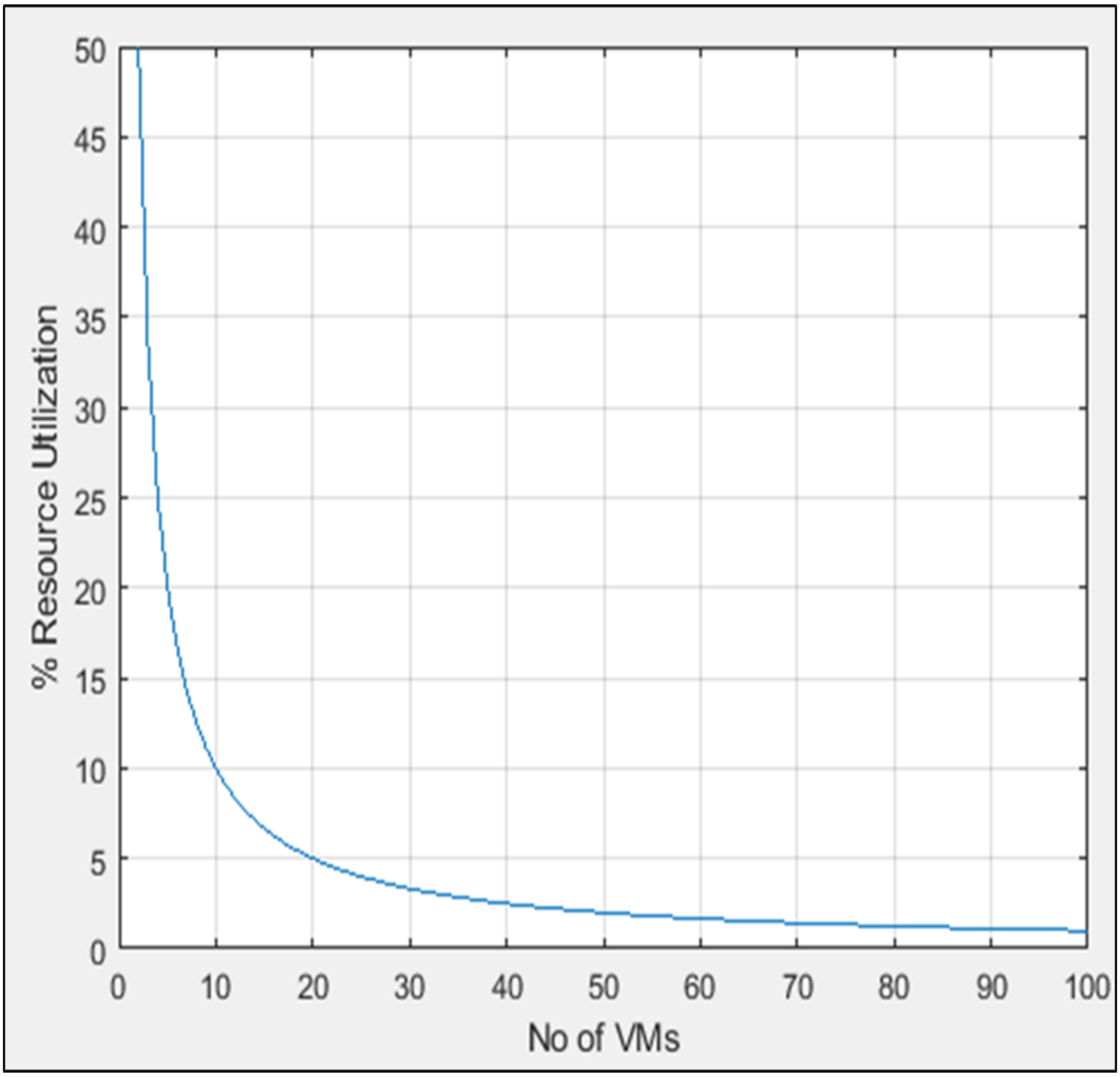


Figure (4.4): Illustrate The relationship between resources utilization and number (VM) server using ICPSO algorithm **.**

Step 4: Calculate the time cost probability of the best location of the server tasks based on the execution time speed and factor of execution physical no latency using equation (3.12) ,(3.14),(3.16) in section (3.2). The physical latency is fixed in network.

Table (4.5): Sample result execution time speed and no physical latency and cost time is fixed in network.

N	Physical no Latency	speedtime	Cost t Tme
1	1	91.16750675	0.01096882
2	1	10.67948786	0.093637449
3	1	94.56518476	0.010574716
4	1	207.4884481	0.004819545
5	1	156.4479587	0.006391902
6	1	69.95435998	0.014295035
7	1	142.2641157	0.007029179
8	1	146.8711772	0.006808688
9	1	140.4153292	0.00712173
10	1	111.9440626	0.008933033
11	1	24.46509084	0.040874567
12	1	67.60057304	0.014792774
13	1	44.55995549	0.022441674
14	1	8.985171091	0.111294486
15	1	76.06054136	0.013147422
16	1	161.4310132	0.006194597
17	1	0.71754121	1.393648178
18	1	45.17544973	0.022135917
19	1	97.9527102	0.010209008
20	1	100.9295844	0.009907898
21	1	36.11540398	0.027689016
22	1	98.20172087	0.010183121
23	1	92.103882	0.010857306
24	1	95.6247662	0.010457542
25	1	76.06121648	0.013147305
26	1	106.2406602	0.009412592
27	1	261.7567832	0.00382034
28	1	4.125118096	0.242417302
29	1	54.97135311	0.018191293
30	1	19.57977173	0.051073118

31	1	129.8452072	0.007701478
32	1	110.4587986	0.009053149
33	1	60.12459217	0.016632129
34	1	32.4845427	0.030783872
35	1	103.4134987	0.009669917
36	1	15.8292952	0.063174007
37	1	139.9784197	0.007143958
38	1	96.15445275	0.010399934
39	1	93.35496022	0.010711804
40	1	45.17529605	0.022135992
41	1	44.00755374	0.022723372
42	1	12.89464789	0.077551555
43	1	127.0473535	0.007871081
44	1	135.6823952	0.007370153
45	1	117.378729	0.008519431
46	1	162.5087008	0.006153517
47	1	152.9449214	0.006538301
48	1	105.8904158	0.009443725
49	1	0.524827549	1.905387784
50	1	102.1317355	0.009791276
51	1	46.82949934	0.021354061
52	1	138.13075	0.007239518
53	1	107.8311952	0.009273754
54	1	7.219219228	0.138519135
55	1	78.2209935	0.012784292
56	1	101.6292952	0.009839683
57	1	56.04025548	0.017844316
58	1	122.1792766	0.008184694
59	1	103.2866533	0.009681793
60	1	160.0561942	0.006247806
61	1	35.12386351	0.028470672
62	1	171.6348967	0.005826321
63	1	2.45435906	0.407438348
64	1	14.04481817	0.071200637
65	1	81.53950304	0.012263994
66	1	78.67869951	0.01270992
67	1	16.18789262	0.061774563
68	1	197.3337828	0.005067556
69	1	126.5827858	0.007899968
70	1	49.11337711	0.020361051

71	1	57.67286296	0.017339177
72	1	3.719210396	0.268874275
73	1	106.0373329	0.009430641
74	1	75.22890703	0.013292763
75	1	221.3965656	0.004516782
76	1	39.17432716	0.025526922
77	1	136.3135572	0.007336027
78	1	16.92979418	0.059067464
79	1	6.708216224	0.149070925
80	1	90.87581197	0.011004028
81	1	50.34329705	0.019863618
82	1	113.8487252	0.008783585
83	1	29.82624119	0.033527523
84	1	107.8148941	0.009275156
85	1	147.3747291	0.006785424
86	1	40.68977022	0.024576202
87	1	88.30216092	0.011324751
88	1	103.7053854	0.009642701
89	1	114.3557517	0.008744641
90	1	144.7550979	0.00690822
91	1	43.93143135	0.022762746
92	1	146.8485919	0.006809735
93	1	168.2345407	0.005944083
94	1	26.79518677	0.037320135
95	1	167.5348718	0.005968907
96	1	26.7872711	0.037331164
97	1	138.63305	0.007213287
98	1	64.50675777	0.015502252
99	1	122.2186339	0.008182058
100	1	15.13876183	0.0660556

4.3.4 The Test Cloud Server

The proposed ICPSO algorithm depended find the optimal server(VM) that is available to deal with MBAN data for storage and analysis. Because the (VM) task that scheduler from data center to server by cloud broker application interface that provides service sharing. The following figure (4.5), shows the existence of (10) servers each one separate from the other, it calculate the probability position best server (VM) using equation (3.1) and(3.2). On each

edge of the figure, the execution time cost is every VM available in the network Show in the figure below the best server and cost (VM) from attribute.

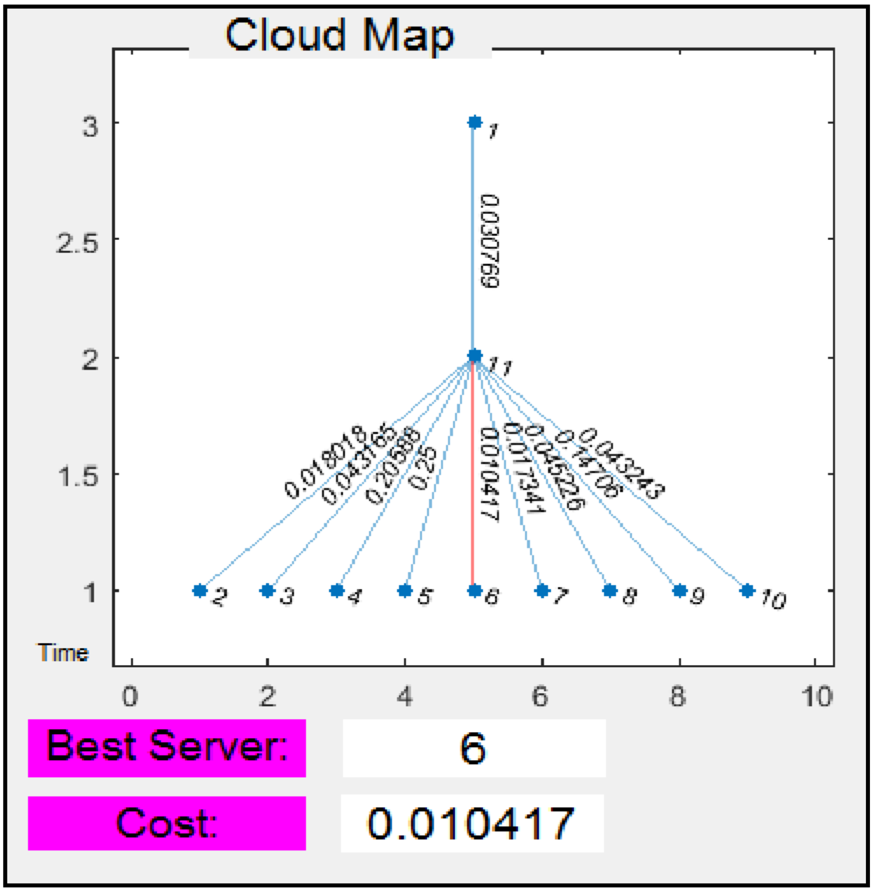


Figure (4.5): Illustrating Probability Location Best Server in Interface Matlab.

In the figure (4.6), the test results are placed on a group of patients in which each patient's information was distributed to a server that was implemented using the VM group. The patient’s information table is set as well as the cost of implementation time VM that performs the tasks of each patient.

	ne	Name	Case	Systolic BP	Diastolic BP	Glocose	Hearbeat Rate	Best VM	Cost
1		احمد جاسم 3	NaN	140	90	120	100	9	0.0071
2		علي عبدالله 6	NaN	95	60	110	128	7	0.0161
3		ارشد عباس 9	NaN	90	70	91	150	2	0.0065
4		صالح علوان 12	NaN	140	90	165	75	7	0.0061
5		علي صالح 15	NaN	130	85	101	101	7	0.0064
6		ماهر فاضل 18	stomachcall	112	63	160	112	10	0.0083
7		سامي محمد 21	NaN	131	81	106	90	6	0.0104

Figure (4.6): Illustrating Data Patient in as Electronic Record.

In the figure (4.7), alert message is placed by the automatic monitoring system that between the patient's condition in each server that has (VM) schedule that contains data for each patient. A program is used using the flag technique, which is a binary indicator (0, 1). Each patient's data is compared in terms of the medical physiological signal (systolic blood pressure, diastolic blood pressure, glucose level, heartbeats rate).

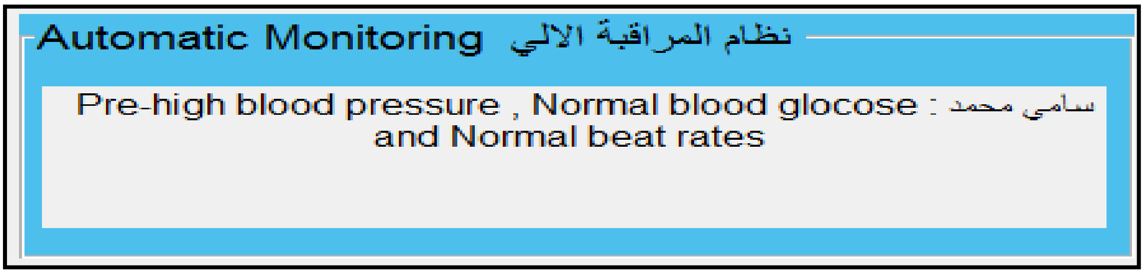


Figure (4.7): Illustrating Automatic Monitoring for Patient in Interface Matlab .

4.5 Performance Evaluation Measures

In this section, the performance of the proposed system is evaluated by the execution time the speed of data processing and the system efficiency the result of the proposed system which is described previously in subsection of chapter three, the implement using and ICPSO algorithm using the equation (3.17)and (3.18) in chapter three shows the obtained results of our suggested system .Execution time speed(ET) ICPSO algorithm and addition future cost time find propaplity location best server(VM).In this case the average ET latency increases by increasing the particles in the different trials.

Table(4.6):Result of the proposed ICPSO Algorithm Average Execution Time no latency and Average Execution Time with Latency.

N	VM	Physical no Latency	Physical Latency
1	100	2.17984	1.01597
2	200	4.31592	3.559965
3	300	6.40176	5.9714
4	400	8.7275975	6.51545
5	500	10.819518	8.879368
6	600	12.92369833	5.487583333
7	700	15.28397714	4.755888571
8	800	17.5678925	12.29793375
9	900	19.61129889	15.87537222
10	1000	21.867788	6.979729

The results of the previous study modified parallel practical swarm(PPSO) algorithm that is compared with the (ICPSO) algorithm which shows from the results in the table (4.5)and (4.6) the variance between these results and the results of the previous experiment. The suggest algorithm which shows from the results in the table (4.5)the implementation minimum execution time compression with (PPSO)the results of the previous study .

Table (4.7) :The Results Of The Previous Study PPSO Algorithm.

N	Number (VM)	Average Execution Time
1	100	5.05
2	200	6.01
3	300	6.68
4	400	7.77
5	500	8.98
6	600	10.11
7	700	11.14
8	800	13.99
9	900	14.15
10	1000	15.78

Performance efficient average execution with latency that was explained in chapter three using equation (3.19), performance efficient average execution with no latency using equation (3.20).

Table (4.8) :The Results Performance Efficient Of The proposed System.

N	Performance Efficient no Latency	Performance Efficient with Latency
1	50.61	71.22
2	50.55	63.97
3	50.56	63.53
4	50.7	73.82
5	50.72	68.39
6	50.73	64.63
7	50.91	65.64
8	50.59	91.57
9	50.75	72.17
10	50.85	74.81

Figure (4.8), the execution time and the number of servers on which the number of tasks is distributed are calculated (VM), efficiency performance rate. The proposed system using network latency time that depends on the previous table using the equation (3.21) and in the case of no latency in the network using the equation (3.22), that was clarified in the third chapter.

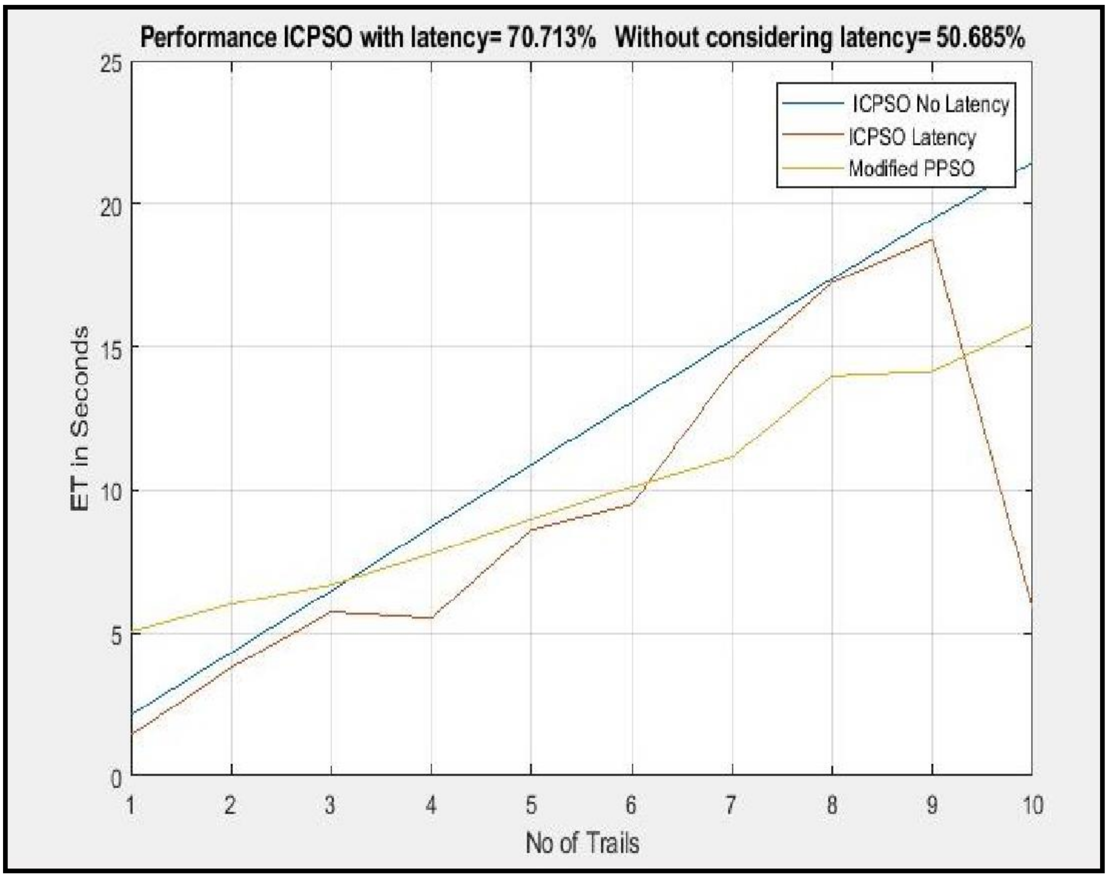


Figure (4.8): Performance Efficient Rate ICPSO Algorithm with Result Compare paper PPSO Algorithm.

In the following equation, the percentage of improvement in the proposed system is compared to the previous systems is based on the results of the previous table (4.7) and (4.8), compared to the previous systems.

Improvement of the proposed system = 100*(Y1-Y2)/Y1 …..(4.1)

Y1= Average ET PPSO algorithm .

Y2= Execution time the proposed ICPSO algorithm .

4.6 Proposed Algorithm vs. Related Works

The proposed system is implemented by one type of discrete algorithm and compared with related works. Table (4.32) illustrates a comparison between the proposed system and the existent works. Based on our results ICPSO is generally more robust than the other methods PSO it believe this is because the particles represent distributions instead of candidate solutions, and thus do not rely on having a gradient or relationship between neighboring states.

Table (4.9): Comparison between Other Existing Works and the Proposed Work.

Researchers	Methodology	Performance efficient	Improves
M. Elhoseny and et al [15]	PPSO	43.9%	5.2%
R .O. Aburukba and et al [16]	GA	21.9% to 36.6%	20%
The proposed system when physical network latency	ICPSO	70.713%	31.77%
The proposed system when no network latency		50.704%	28.44%

Program interface the proposed system that was implemented Matlab program demonstrates the mechanism of action and the basic elements of the test set of the database described the probability of distribution using the algorithm proposed each server was scheduled data patient patient set tasks .

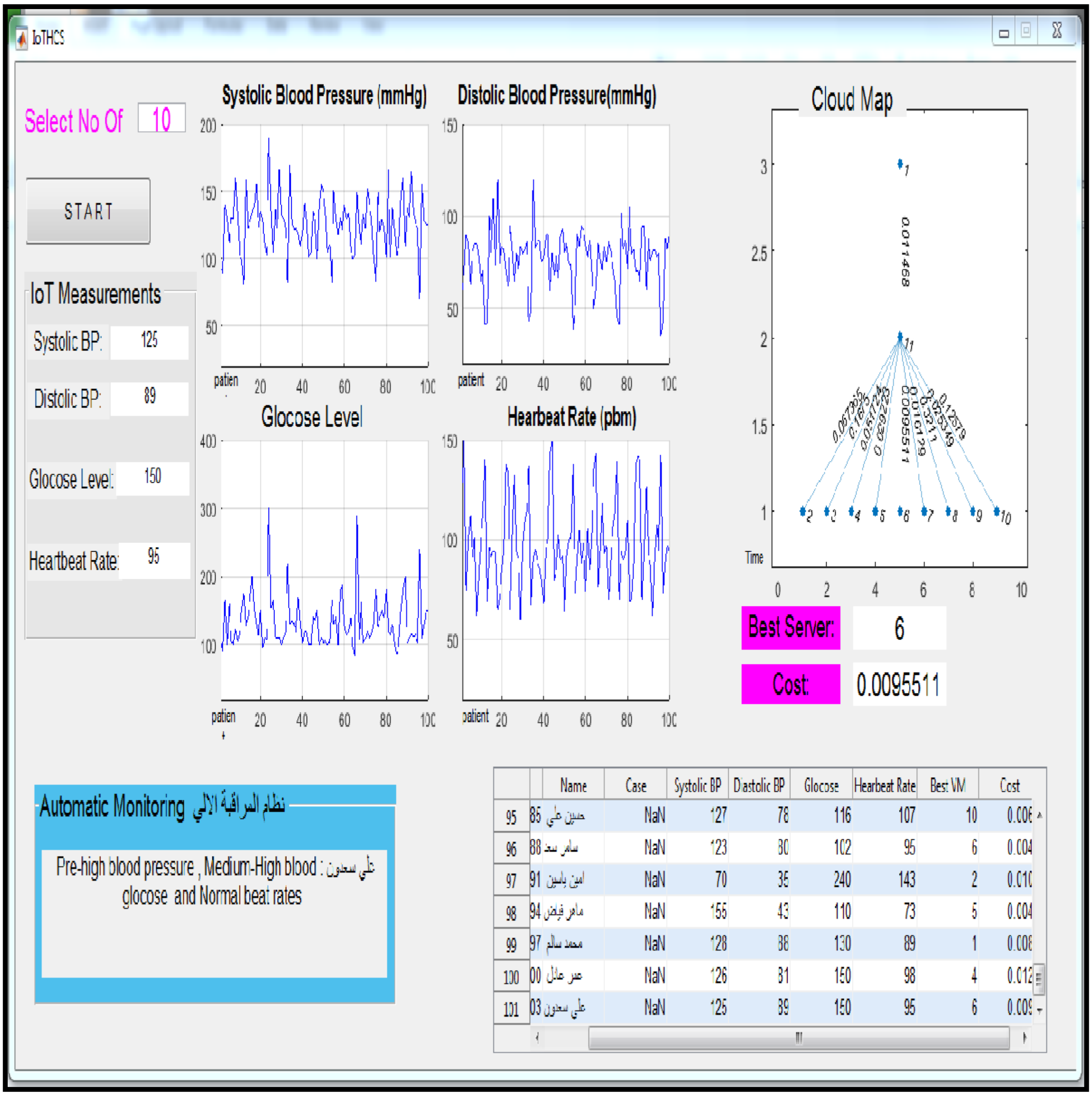


Figure (4.9): Program Interface Matlab the proposed system .

Chapter Five

Conclusions and Suggestions for Future Works

Chapter Five
Conclusions and Suggestions for Future Works

5.1 Conclusion

Several conclusions have been deduced from the obtained test results. In the following some of these conclusions are listed:

- The goal of the proposed system to enhance the performance of the health services in a CLoud -IoT for UCI health system depending on base behavior by selection optimal of server (VM)optimization and provide patient monitoring Knowing the patient's condition that is comparing the values that represent patient data(blood press ,heart rate ,glucose level).

- The proposed system is applied by proposed ICPSO algorithem discrete optimization. The goal of the proposed system to determine the best selection of server(VM) to aid MBAN patient in reduce cost time using seven attribute in network (TT ,WT, CPU(U),execution speed time , physical latency, physical no latency, cost time) ,of MBAN patient task depend on three secondary attributes (arrival time, completion time , barst time) and attribute improving scheduling of the task, maximizing resources utilization). And retrieving storage data of patient powerfully.

- The proposed fitness function is a composition of less cost time a probability particle position implementation attributes. The speed of data processing, and the efficiency of system.

Performance efficient of the suggested algorithm 70.713% when physical (network) latency 50.704% when no physical (network) latency .

- The proposed model is tested against the state-of-the-art method to evaluate its effectiveness. The simulation results show that the proposed model outperforms on the state-of-the-art models average CPU time is (2 milliseconds). Improvement of the proposed model over Previous study is (28.44%) when no network latency is considered and (31.77%) when physical network latency parameter is considered.

5.2 Suggestions for Future Works

The possible future works for cloud IoT take several directions including:

- Adapting the proposed system for problem big data health system in various environments to make the system more efficient.
- Use of the methods of Markov ICPSO optimization algorithms to generate more features in system.
- Increasing the efficiency of smart sensors make them directly reach the fog cloud by providing them with large-scale networks .
- Develop on the system using the characteristics of the packet loss, bandwidth and delay.
- To develop a system which makes use of commercial products which are readily available to the public while also maintaining a relatively low cost.

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الخالصة

ذلعة أًظوح السعاٌح الصحٍح القائوح على خدهح اًرسًد االشٍا والحوسثح الحٍحاٍح زا هً وٍا ٍ رو

نقٌٍاخ الوعلوهاخ واالذصاالخ ، كوا أًٌا ذحاهن ً ذطوٌس أًظوح الوعلوهاخ الطثٍح وهساقثح السعاٌح الصحٍح للوسضى.

هدف الٌظام الوقرسح للعثوز على أ ضل خارم)VM(عٌد وجىر شٍث ح ًٌرسًد االشٍا الرٍ ذ ٍوى ًٍاًاخ كثٍسج هي MBAN ذطوٌس أرا أسالٍة السعاٌح الصحٍح هي خالل نقلٍل ووقد ذلفح الوحرخدم MBAN لرٌفٍر ذخصٌي الثٍاًاخ ال ثٍسج هي الوسضى اا هثل ، وذو ٍس الوقد الفعلً لحٍث ٌٍرن ذو ٍس الوقد والر لفح ً ًظام السعاٌح الصحٍح. عالوج على ذلك ، إًي ٌحاعد MBAN علٍى نقلٍل ووقد االًرظاز ، ووقد الرحول لالترٍاجاخ الطثٍح علٍى الثٍ،ح الحٍحاٍح ، ونقلٍل اسرخدام ًفاٌاخ وتٍدج

الوعالجح الوسكصٌح هي االجًصج الظاهسٌح ، واسرغالل اسرخدام الووازر.

ذحروي الثٌٍح الٌوورجٍح الوقرسحح لـ cloud-IoT على أزتعح ه وًٍاخ زئٍحٍحأ أجًٍصج (MBAN (user، IoT Router ، وسٍس سٍحاتح وخارم سٍحاتح HCS. لرعصٌٍص اخرٍاز)VM(تواسطح ، ذحرخدم الخوازشهٍح الوقرسحح االلتروٍاالخ الوٍرسكح الوحلٍح ٍٍي أشوال هرغٍساخ الحالٍح لروثٍل

الرثعٍاخ الرً ذحوى صساتح خوازشهٍح)ICPSO(الوحرخدهح إلًما ًظام هقرسح.

اترحاب سسعح ووقد الر لفح الرً ٌحراجًا)هحٍرخدم MBAN(، ذ ٍوى الويٍنح الوقرسحح للويٍفح عثٍازج عٍي سٍثعح سٍواخ هًوح ذحٍرخدم وتٍدج الوعالجح الوسكصٌح)CPU(ووقد الرحوٌل ووقد االًرظاز ووقد سسعح الرٌفٍر وشهي الوصول عٌدها ٌ وى هرغٍس او ثائد وقد الصهًٌ الراخس ".

ٌرن الرحقق هي الٌظام الوقرسح هي خالل اا عوال الحائقح لروقٍٍن كفا ذ . ذظًس ًرائج الوحاكاج أى الٌظام الوقرسح ٌد ذن نقٍٍو ًفا ج للخوازشهٍح الوقرسح)70.713%(عٌدها ٌ ٍوى هٌيام شهٍي أرقٍال شٍث ح

علً ،)50.704%(عٌد عدم وجور شهي أرقال شث ح علً.

هروسيس وقد وتٍدج الوعالجيح الوسكصٌح)2 milliseconds(. ٌ ٍوى ذحٍٍي الٌظيام الوقريسح عليى الدزاسح الحائقح)28.44%(عٌد عدم هساعاج شهي أرقال المث ح و)31.77%(عٌد أخر هرغٍس شهيي أرقال المث ح الفعلٍح ً االعرثاز.

وزارة التعليم العالي
والبحث العلوي
جاهعت ديالى
كليت العلوم قسن علوم
حاسوب

نظام صحي فعال باستخدام ICPSO

رسالة مقدمة إلى مجلس كلية العلوم/جامعة ديالى وهي جزء من متطلبات نيل درجة الماجستير في علم الحاسب وة

تقدمت بها الطالبة هاجد شكر

اشراف

أ.د. ظاهر عبد الهادي عبدالله

1441 هـ العراق **2019 م**