

UMP MEDICAL REF

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STEM USING

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ABSTRACT

Refrigerators in hospitals, clinical laboratories, pharmacies and biotechnology research laboratories are used to place medical samples which include blood, urine, serum and tissues. These samples need to be stored properly at a constant temperature normally at 4(±1) degrees Celsius to sustain their properties when used. Thus, these medical refrigerators need to be reliable and designed to meet strict requirements established by medical authorities to ensure an optimum level of performance. The paper proposes a temperature monitoring and alert system for medical refrigerators with the aid of Short Message Service (SMS). A temperature sensor will continuously check the current temperature of a medical refrigerator and send a SMS whenever the temperature is not the same as the set temperature. The SMS will inform the user/users on the condition of the refrigerator's temperature for the user to take further actions in order to save the medical samples from getting spoilt.

ABSTRAK

Peti sejuk yang terdapat di hospital, makmal klinikal, farmasi dan makmal makmal penyelidikan bioteknologi digunakan untuk meletakkan sampel perubatan seperti darah, air kencing, serum dan tisu. Sampel ini perlu di simpan dengan baik pada suhu malar pada 4(±1) darjah Celsius bagi mengekalkan sifatnya apabila perlu untuk di gunakan. Oleh itu, peti sejuk perubatan ini perlu direka untuk memenuhi keperluan yang di tetapkan oleh pihak berkuasa perubatan untuk memastikan tahap optimum prestasinya. Tesis ini mencadangkan sebuah system pemantauan suhu dan system amaran untuk aplikasi peti sejuk perubatan dengan bantuan Khidmat Pesanan Ringkas (SMS). Alat pengesan suhu akan di gunakan untuk menyemak suhu semasa peti sejuk perubatan secara berterusan dan akan menghantar SMS sekiranya suhu semasa tidak sama dengan suhu yang telah di tetapkan. SMS tersebut akan memaklumkan kepada pengguna tentang suhu peti sejuk supaya pengguna dapat mengambil tindakan selanjutnya untuk mengelakkan sampel perubatan daripada rosak.

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LIST OF ABBREVIATIONS

UMP	Universiti Malaysia Pahang
IDE	Integrated Development Environment
IBM	International Business Machines Corporation
SQL	Structured Query Language
HTML	HyperText Markup Language
DB	Database
SDLC	System Development Life Cycle
CPU	Central Processing Unit
RAM	Random Access Memory
HDD	Hard Disk Drive
GSM	Global System for Mobile
SMS	Short Message Service
DFD	Data Flow Diagram
USB	Universal Serial Bus

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Refrigerator is a common machine used as a part of families, commercial ventures or industries and hospital which consists of a thermal insulator and a heat pump that exchanges heat from the inner part of the fridge to its outside environment. Subsequently making the inner part of the refrigerator cooler and below the ambient temperature of the room temperature.. The backs idea or concept of a refrigerator is to decrease the rate of spoilage of food or samples that being stored by decreasing or keeping away the reproduction of bacteria.

Before the invention of refrigerators or freezers, icehouses were used to provide cool storage area to store food or medical samples in hospitals. Usually, medical sample in hospitals are stored at a temperature of $4 (\pm 1)$ degrees Celsius. The medical samples are stored at lower temperatures to avoid the production n of bacteria that can spoil the samples. The first known artificial refrigeration system was demonstrated at the University of Glasglow in 1948 and was developed throughout the years till today. Nowadays, there are various design of refrigerators available with various features to offer

1.2 Problem Statement

The old style of medical refrigerator is not efficient because can't be notified if any failure happens. Usually, the medical refrigerator is used to store medical sample such as urine test, blood human tissue or organs and medicine that need to be refrigerated. Thus it is weighty to guarantee that the refrigerator is always is a good condition to keep the sample or medicine can sustains their properties in a period time and can be use when they are needed. These days, some medical refrigerators are equipped with an external continuous power supply (UPS) unit that will work once the main power supply is disconnected. The UPS unit has the capacity supply power to the refrigerator for up to three (3) hours.

Problems emerge when the power storage gets detached or could no more supply power to the refrigerators which may cause the stored medical samples to be in an uncontrolled temperature condition. This will lead to the samples getting spoilt over a time of time which may further prompt the loss of cost.. One approach to overcome this issue is by using a temperature sensor to identify and monitor the temperature of the refrigerator continuously and creating an alert system to alarm users whenever the refrigerators malfunctions. This enable user to take fast action to avoid these medical samples from getting spoilt.

1.3 Objective

The objective of this project is to develop a Medical Refrigerator Alert System in UMP Clinic. The following *objectives* are

- i. To design a constant temperature monitoring system for medical refrigerator at UMP Clinic
- ii. To inform with a sms notification whenever the temperature is out of range and send a text message to someone who in charge
- iii. To ease the in charge person can monitoring the temperature of freezer

With the proposed system, users are capable store their medical samples securely and make suitable move quickly at whatever an unwanted situation happens.

1.4 Scope

1.4.1 Target Organization

The application will be develop specially for Universiti Malaysia Pahang (UMP) Clinic. The purpose is to build a new system of to monitoring and to give a sms notification so if any failure happen to medical refrigerator. The main objective of developing the application is to aid more convenient workflow of managing medical store.

1.4.2 System User

The system target user is the pharmalogical in specialty UMP clinic and hospital. Pharmacist will use the system to monitor the medical refrigrirator and to alert with the sms notification is any failure happen to the refrigerator.

1.4.3 Function

The function of this system is to ease the work of managing the refrigerator build a alarm system that can give a notification by sending the sms to the in charge person.

1.4.4 Application Platform

This application will be build and run using arduino system as a platform because it is ease to configure and maintained the device. Thermostat as the temperature sensor is use to regularly measure current temperate of the refrigerator. The microcontroller (Arduino Mega) will trigger the GSM and interpret data from temperature sensor if there any difference between the measured temperature and the set temperature.

Mostly this project has two major scopes there is the software part and hardware part. The scope of this project subsist of three major parts which is the microcontroller, temperature sensor and Ethernet Shield to integrate with Twilio.To continuously measure the current temperature of refrigerator, the temperature sensor has been implement as the temperature detector. The microcontroller used in this project is Arduino Mega which will interpret information data from the temperature sensor and will compare with the set temperature. The microcontroller is associated with the Ethernet Shield and will trigger the Ethernet Shield and Twilio API if any the set temperature is differ with the current temperature. The GSM will send a message to give alerts of the latest temperature of the refrigerator.

1.5 Conclusion

This chapter gave a briefly introduction to the Medical Refrigerator Alarm with SMS notification in general, as well as the step by step of development life cycle to achieve the project goal. It will introduce the main purpose to build the system, scope of user and general components of the application development including development platform and methods. The goal is set and few objectives are stated to be achieved by the end of this project. The problems exist that resulted in this project development are also identified. The scope of these plication is set so that any procedure or methods planned to be utilized for development is the suitable one. The development life cycle is

explained briefly to clearly describe the whole process of development to achieve success in this project. It is desired with the plan and procedure in this chapter will provide better facilities and guides for the mobile application development to proceed systematically.

CHAPTER 2

LITERATURE REVIEW

The concept of the entire project which is to continuously checking and monitoring temperature in refrigerator and sending a short message service (SMS) to alarm the user about their refrigerator status and condition keeping away from their medicine sample and from getting ruin.

2.1 Overview

In this chapter, there will have five subtopics that will describes the definitions and the method of the Medical Refrigerator Temperature Alert System using SMS Notification.

Subtopic 2.2 will detailed the definition and structure of refrigerator. Subtopic 2.3 will describe and discuss about Temperature Controller, while subtopic 2.4 will define the concept of GSM. Subtopic 2.5 will explain on the Material and Device used Medical Refrigerator Temperature Alert System using SMS Notification.

Overall contents in this chapter will cover the detail data of the method implementation that will be used in this project.

2.2 Refrigeration

Refrigeration is the heat moving process starting from one point to another and its normally from high to low temperature. This refrigeration process is utilized in multiplied applications including industrial freezer, air conditioners, and a refrigerators. For refrigerator there have various type of its included for domestic use, industry and also for medical use with multi designs. These refrigerators are designed to fulfill the needed and their functions.

In the medical sectors, refrigerators area used to store medical samples such as urine, organs, tissues, and blood to stay out them from getting spoilt. In pharmacy,

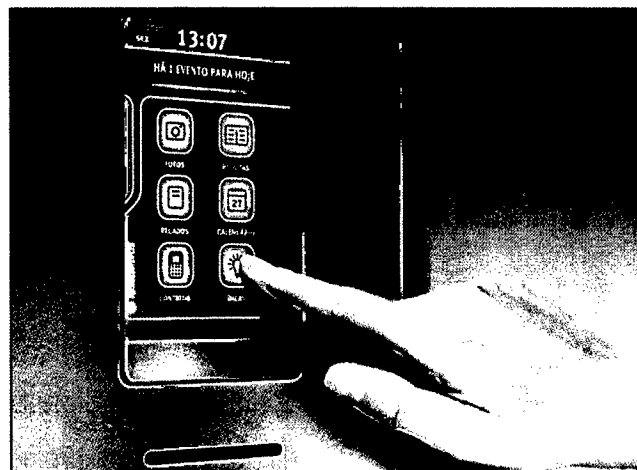


Figure 2.0: Example of Intelligent Refrigerator

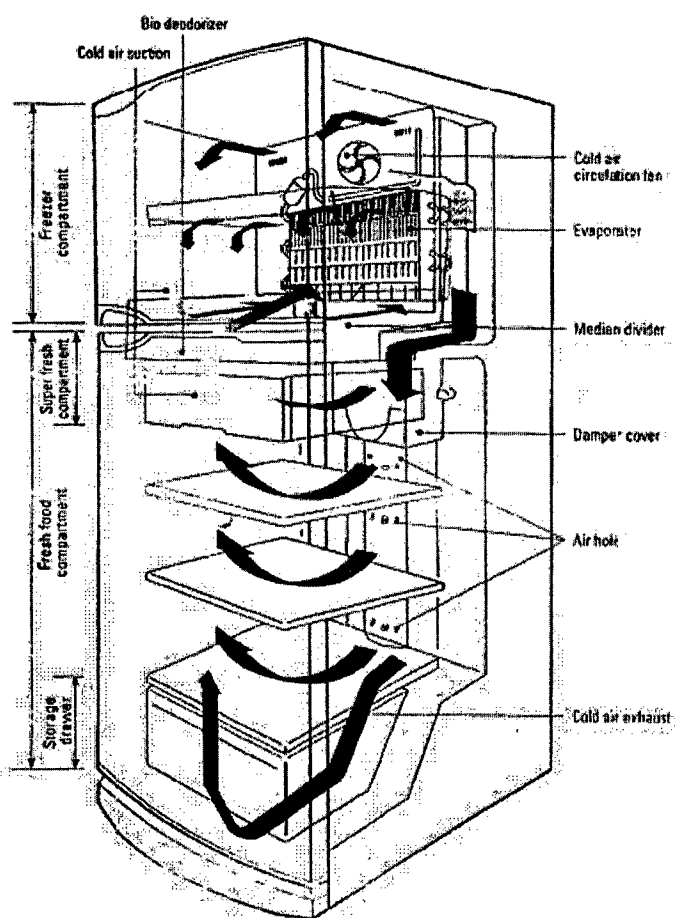


Figure 2.1: Schematic Diagram of the Refrigerator

Chromatography samples, to meet the temperature requirements and the dimensional of the scientific community, freezers and blood bank refrigerators and must be designed properly and follow the requirement specification. In form to get the best possible results, the samples must follow the guidance for handling, storage and administration

Domestic refrigerators are utilized to store drinks and foods and in every home it becomes one of the most needed appliances. Recently, there was new invented of refrigerators which are known as 'smart' refrigerators, as shown in Figure 2.0. These

smart refrigerators are supplied with LAN port which enables internet surfing and shopping and its own TFT-LCD screen. In addition, using these refrigerators users can also watch television and there is a built-in recipes to help them to prepare their favorite dishes [1]. Besides that, the refrigerators are build up with speakers, a small video camera and microphone which permitted the family members to leave video messages among other each. The applications that are introduced in these smart refrigerators are extremely valuable and will be a great significant to the users which make life simpler and easier..

The diagram in Figure 2.1 demonstrates a basic schematic diagram of a refrigerator. The temperature sensor is built in refrigerating devices. The function of temperature sensor is for detecting temperature . Each of these modules has its own specific function that supports to control of a refrigerating unit. The examination circuit compared the value voltage with the reference voltage value [2]. The method is utilized to discover any disappointment of temperature sensor. The refrigerator cycling drive circuit is used to operate a cooling system to a compartment to rely on the estimate of the voltage. The idea in the first stage to be cooled, the reference voltage range in a normal temperature level for the refrigeration system device, and in second express the reference voltage incorporates the example and reference voltage go in the first phase. The failure of temperature sensor can be identify if the value of voltage is outside the scope or range of the reference voltage.

The above design was made as there were a few problems with the temperature sensor because to discontinuity or disconnection failures. When any failures happen, the temperature give a signal voltage was too high compare to the power source of DC. The effect was the refrigerating cycle device will evaluate the temperature inside the cooler or refrigerator as to a very high in fact it was only because of the intermittent failures. Therefore, the temperature in the refrigerator is going to be extremely low and finally spoiling products store in the refrigerators [3]. Other than that, the temperature signal voltage will become 0 and the temperature in the refrigerator to will be determined as extremely low when disconnection failure occurs. Thus, the cooling system will not run

and the internal temperature of the refrigerator will be so high that eventually spoiled food or sample in it.

There was also a issues cool when the temperature load was high and low and time taken for the refrigerator become more increases. Thus, additional features on monitoring and controlling the refrigerator's temperature were taken into consideration which was to make sure the time taken is reduced for refrigerator become cool when the load of temperature is high and decrease the cooling capability and the time taken when the temperature load is low. To accomplish these objectives, a device was designed to provide the system with a better temperature control of the refrigerator by increasing the rpm of the compressor. To smooth the operation and to increase the performance, the compressor's speed was made to be controlled by means of digital control signals between certain predetermined positive and negative value. [4]

These days, most refrigerator have two (2) evaporators which contains two fans for releasing cool air produced from the evaporator into a solidifying and a refrigerating compartment [5]. This two fans are installed at the refrigerator and freezing compartment. Their functions is to provide

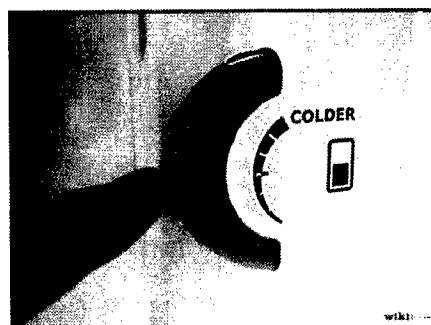


Figure 2.2: Example of Temperature Controller

an systematic cooling impact on each of the compartment so that the cooler can be cool quicker and to guarantee the reliability on temperature at any part of the refrigerator.

The refrigerator will just release cool air towards a predetermined direction if there is no fan installed, which means that the focal point of the compartment will be cooler than alternate parts. The temperature distribution of the refrigerating sections gets to be not systematic and this will ruin the food or sample in the refrigerator. By having two evaporators, the achievement of the refrigerator had been enhances and will work extra easily and smoothly.

2.3 Temperature Controller

In Figures 2.2 is the temperature controller and it is one of the most important parts in a refrigerator. To desired control the temperate, the temperature controller will compares to the actual temperature. The input of the temperature can either be from the RTD or thermocouple. The temperature controller can likewise be utilized for weakening coolers which will consequently control the blending chamber temperature [6]. Other than that, it is additionally used for as a part of vitro recording chamber which will give natural temperature in chambers used to keep up tissue slices for in vitro recording [7]. Basically, there are many types of temperature controller that are used in refrigerators which includes the auto tune controllers, on/off control, a safety limit controllers and multi loop controllers. Temperature controllers are important as it capacities and functions to monitor the temperature of the refrigerator so that it is not too low or high from the desired temperature.

An algorithm of the refrigerators with neural network and fuzzy logic is introduces so the effectiveness of the refrigerator's temperature control is increase. A fuzzy system of control is made out of an active controller object, sensor and an I/O and fuzzy controller. Using a fuzzy logic controller function will help to give a better performance , higher energy savings and provide a constant temperature of the fridges [8].On the other hand , the neural network pattern allocates the consumer to use the refrigerator. Results from the neural system will be utilized as the data to the fuzzy logic. In order to get a clearer picture, the error rate between the desired temperature and the actual temperature are used as the input of the fuzzy logic. The internal temperature is identified by the neural network and the user pattern is based on the numbers of door openings per designated. The customer or user design by the neural

network is used by the fuzzy logic and other input signals fuzzify the system to cool the refrigerator as indicated , by creating the signals.

For an addition, temperature controllers are not just utilized in refrigerators but temperature controllers also applied in either situation that needed a given temperature to be kept stable. This is possible in the situation in which an object must be heated, cooled , or both , and the temperature remain the set temperature [9].. It is a simple device to utilize and a much of the time utilized basic model has a user interface with a handle, which you can turn either clockwise or anticlockwise depending on whether you need to raise or bring down the temperature. The easiest and simple situation of a temperature controller application is a typical thermostat regulator found in home appliances, for example, oven, air conditioner and hot water heater. When a temperature is set for a hot water heater as example, the temperature controlled will verify the current temperature in the water heater. If below the set temperature it will send a signal to activate the heater to back to the set temperature. If not, when it is high than the set temperature, a controller will initiates an action to bring down the temperature. Other than that, temperature controllers are likewise broadly used in industry which includes thermos forming machine, blood bank, food processing and food storage.

There are a few controllers that can be utilized relying on the system used. The three types of basics of controller are, on-off, PID and proportional. An on-off control is the least difficult nature , that a power on or off without reference to the central state [10]. The controller will just switch out the output and this all will happen when the temperature crosses the set point. The second controller is the corresponding controller which is intended to dispense with the cycling associated in connection with on- off control. When the temperature approached the setpoint, the controller will reduce the average power forced supply it to the heater.

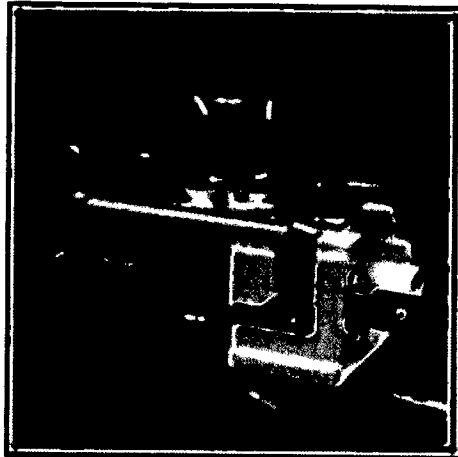


Figure 2.3: Thermostat

A temperature controller regularly cooperates with thermostat as the temperature sensor. As it offers incredible stability and sensitive. These days thermostats are getting to be more famous as it able to regulate the temperature automatically. Typically the thermostats has been used as a part of home appliances have similar features, inertial , non-linear and time variant.. There are two types of thermostats which is the pipe thermostat and the immersion thermostats. The pipe thermostat has only one type that is AT type. The typical characteristic of these thermostats are presented in Figure 2.4. Whereas the immersion thermostat subsist of five different types of thermostat that is KTM, KT, DTO 1, DTO 2 and DTM. [11]

Technical Data								
		KT	KTM	DTM	DTO 1	DTO 1A	AT	
Temperature range TR	°C	25-95		25-95	25-95	63-87	30-90	
Temperature differential TR	K	5		5			8	
Temperature range TW	°C		50-110	50-110				
Temperature differential TW	K		5	5				
Break temperature STB	°C				100	100		
Max. sensor temperature	°C	T _{s130}						T _{s90}
Max. pressure to sensor	bar	40						
Max. ambient temperature	°C	T _{s85}						
Switch system TR, TW, STB		SPDT						
Switch load TR, TW		16 (2.5) A/250V~ 10 (1.5) A/400V~					6 (2.5) A/250V~ 0.1A/250V~	
Switch load STB		1-2: 16 (2.5) A/250V~ 1-4: 0.5 A/250V~						
Enclosure		IP 40						
Weight	g	400	400	465	425	430	160	
Cable connection		2-core Ø 20.5 mm for PG 13.5					PG 69	

TR: Boiler thermostat
TW: High limit thermostat
STB: High temperature output

Figure 2.4: Characteristics of Thermostat

2.3 Cloud Communication (IaaS)

In this project, to enable the sms notification, it will not use the GSM Shield but Cloud Communication (IaaS). **Cloud computing** allows application software to be operated using internet-enabled devices. Clouds can be classified as public, private, and hybrid [12]. The application that will choose is Twilio. **Twilio** is a cloud communications (IaaS) company based in San Francisco, California. Twilio allows software developers to programmatically make and receive phone calls and send and receive text messages using its web service APIs. Twilio's services are accessed over HTTP and are billed based on usage.

Infrastructure as a Service (IaaS) is one of the three fundamental service models of cloud computing alongside Platform as a Service (PaaS) and Software as a Service (SaaS). As with all cloud computing services it provides access to computing resource in a virtualized environment, “the Cloud”, across a public connection, usually the internet. In the case of IaaS the computing resource provided is specifically that of virtualized hardware, in other words, computing infrastructure. The definition includes such offerings as virtual server space, network connections, bandwidth, IP addresses

and load balancers. Physically, the pool of hardware resource is pulled from a multitude of servers and networks usually distributed across numerous data centers, all of which the cloud provider is responsible for maintaining. The client, on the other hand, is given access to the virtualized components in order to build their own IT platforms.

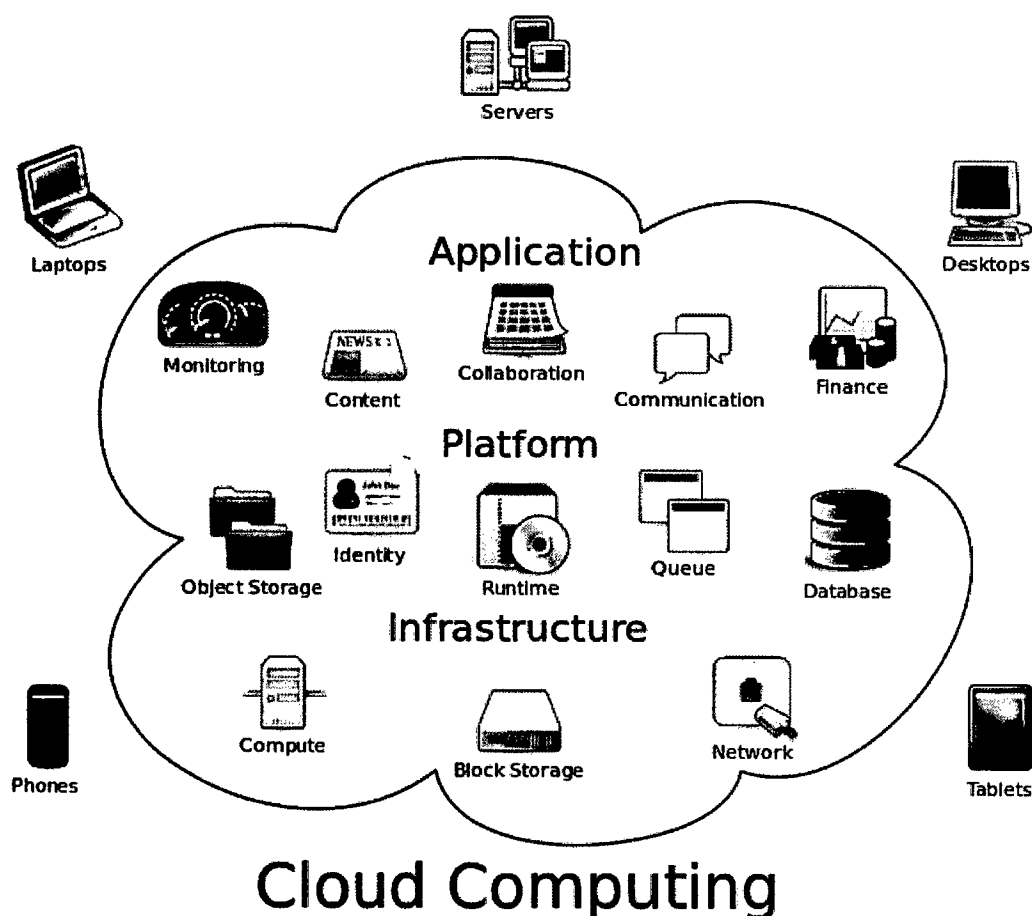


Figure 2.5: Cloud Computing Organizations