A New Concept in Modern Industry Sector, "Virtual Industry Model"

By

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Declaration

This is to certify that the thesis work entitled "A New Concept in Modern Industry Sector, "Virtual Industry Model" "has been carried out by Md. Badiuzzaman in the Department of Industrial Engineering and Management, Khulna University of Engineering & Technology, Khulna, Bangladesh. The above thesis work or any part of this work has not been submitted anywhere for the award of any degree or diploma.

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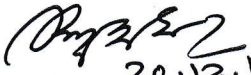
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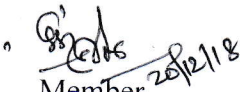
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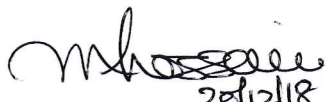
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iii

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The Author

Abstract

Virtual office has become a popular and desired office management system for technology-based low-cost office management system. This virtual management system is a new way of working that enables the virtual worker to work outside the walls of the traditional office. In this system, all the administrative functions of an organization are not necessarily geographically centered in one office. The process of designing and implement a low cost and effective "Virtual office management system" has been introduced in this work. The total system works using software which is named "Virtual Industry Model." The software contains a secure database system and another computing method as required for industry. It is also interesting that using software and the total process will be automated and computerized what is a big deal in the industrial process. Finally, the system was applied to manufacturing, production and service operations. The results show that from the viewpoint of decision making, product design, production planning, production control to marketing, they were able to save their, time, their money and found the operation management easier.

Keywords—Industrial Management, Virtual office, Virtual workers, e-commerce, ICT tool, Virtual organization

Contents

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

ACRONYMS

Virtual Office (VO)

VR (Virtual Reality)

VE (Virtual Environment)

PHP (Hypertext Processor)

HTML (Hypertext Markup Language)

CSS (Cascading Style Sheet)

HRM (Human Resource Management)

SHRM (Society for Human Resource Management)

ECMS (European council of modeling and simulation)

OS (operating System)

SQL (Structure Query Language)

ERD (Entity Relationship Diagram)

GUI (Graphical User Interface)

R&D (Research and Development)

PDA (Personal Data Assistant)

SCR (Service Confidential Report)

CAD (Computer Aided Design)

OCR (Optical Character Reader)

IT (Information Technology)

ICT (Information and Communication Technology)

ERP (Enterprise Resource Planning)

SEO (Search Engine Optimization)

FIFO (First In Frist Out)

IoT (Internet of Things)

AI (Artificial Intelligence)

CHAPTER I

Introduction

The term "Virtual" indicates something not exists in the real world physically, but anyhow it fulfills the requirements of real things [1-4]. Using computing technology a system could be developed as an alternative to a practice which is known as the virtual system. For example, data can be stored in a virtual memory which refers to an imaginary set of locations, or addresses. Virtual systems integrated with many real things in this era. From the last decades things like education, computing, markets, social activities developed toward virtual based on modern technology. Scientific management evaluating day by day, there are lots of management technique and strategies that was unavailable before. Hence the work also a little bit evolution and mix-up of modern technology with management strategy to get better output in management aspects. Still many tools available to manage and coordinate in industrial sector but some manual communications exist on those modern systems. For example when any supreme want to assign any task to his subordinate he needs to send it manually using human resource like MLSS/peon. In Bangladesh most of the industry and other office operating such activities using human which causes higher lead time to complete the task which is not cost effective and challenging to record keeping. Another example, arranging official meeting or any discussion requires a physical space in current situation.

Moreover, it is difficult for an entrepreneur to initiate a new business/industry due to high investment in physical assets. Therefore, modern technological support can reduce some of operation and business communication related cost. If any entrepreneur thinks to start a new business idea he must have to invest in land/space, labor, infrastructure and management processing. It is possible to make these elements of business more affordable according to monetary value. Smart computerized processing that will make entrepreneur and running industries cost-effective and faster in operation management. Considering low cost and fast business communication, avoiding physical space, connecting workers from far away, time to time process monitoring and record keeping, a smart computerized system can make the

existing management systems connected merely. Another critical need is human resource monitoring and evaluation, which is pretty tricky and lengthy in manual operation management. To make existing management flawless and more effective enhanced management software has been developed in this study named "Virtual industry model" that could be used for production-based industry or service based industry. Virtual industry model consists of some modern technology, tools, and some new working process. It is a proposal for an alternate solution to establishing an industry, business startup or operating an existing organization without real office space and other expensive infrastructure. Now a day, freelancing introduced into many professions, outsourcing is a most popular working process in the IT field where people can work for any industry situated far away from staying their home. By using this software people (designers, engineers, manager, and other employees) can perform their task from their residence or any place. The software contains a secure database system. In this study, we used the name "virtual industry" which means any academic institution, public office or production industry.

1.1 Objectives of this Study.

In this study, an industrial management software has been developed and the specific purposes of this study are:

1. To develop a virtual industry/ office management software on the basis of virtual industry concept.

2. To verify the effectiveness of the software by application of it on one or more organization.

1.2 Outline of the Thesis

The thesis is organized as follows. Chapter 1 presents an overview of virtual organizations and states the objectives of this thesis. Chapter 2 describes the literatures review. In chapter 3 software development process is described. Performance test of this virtual model software and results is presented in Chapter 4. The conclusion and further research direction is presented in the Chapter 5.

Chapter II

Literature Review

2.1 Review of Literature

Virtualization not started in the 21st century, the concept of virtualization started early of 1960's in computing technology. In that time computer scientists invented the virtual machine as an alternate of real hardware which was the beginning of virtualization that is being used vastly in every sector in the current area. Pooja Kedia et al. survey the upcoming virtualizations trends [5]. Survey results provides a clear picture of virtualization of different organizations and indicate that virtualization has become a popular field of rendering IT services. Ning et al. proposed a method for resource virtualization by transforming manufacturing resources into cloud manufacturing system through two phases [6]. These method may be served in to heterogeneous applications in cloud manufacturing systems. B.S.R. Amorima et al. Proposed a virtual organizations approach for Business Process Management services [7]. This organizational model can be served as guidelines for the implementation of new processes, which will extend the product lifetime and quick response for organizational changes. H. Castroa et al. proposed a Meta-Organization framework for manufacturing small and medium-sized enterprises to establish a sustainable environment for the hyper-competition market [8]. They concluded that their model can be used for manufacturing small and medium-sized enterprises for the hyper-competition environment. In another work, Joshua Grodotzki et al. developed a virtual experimental lab for engineering education 4.0 [9]. The key finding is that, virtual lab can be saved a significant amount of material and operation costs. Badiuzzaman et al. investigated the impact of virtualization on industry sector [10]. Virtualized management can be saved time and cost and increased productivity. In another research, Badiuzzamn et al. developed a virtual office software for Entrepreneur and e-Management [11]. They developed a structure of all working process of an industry trough internet and others ICT tolls in where total system is operated using online software that is communicate, synchronize among all segment of production process. Results show that, entrepreneurs can fulfill their dream by establish an industry in very low cost, less paper works as well as they can make their product more versatile compare to the other traditional industry.

An article named "History of Virtualization" contains the early period history of virtualization. Gradually virtualization introduced into modern management strategy [12]. Most recent virtualized management strategy is the virtual office. The first virtual office was established by Ralph Gregory of Boulder, CO, in 1994. At the time, leases for official suites were a big issue related to cost, and there was a sore requirement for a more flexible arrangement. To provide for this major gap in service, Gregory founded his company – The Virtual Office, Inc., thereby gives rise to what is now a multi-million-dollar global industry [13]. They incorporated a virtual secretary to reduce pressure on their physical staff. In a previous couple of years, virtual workplaces have been a popular method in the expert world. In 1980 a company named "Servcorp's Virtual Offices" [14] was founded. Probably it was the first commercial virtual management service provider commercial organization. The next necessity was hiring expert employees from around the world for a reputed organization, to solve the problem industries started hiring an expert from the remote location. The survey results of the Society for Human Resource indicate that, developed countries like the USA have the highest number of virtual workers [15-16]. Ira M. Weinstein depicted the potency of the virtual office in his book (The arrival of virtual office-2005) [17]. He mentioned that "Virtual office solutions allow geographically dispersed employees to work together as if they were in the same physical workspace." So it is clear that according to requirements high-performance communication and connecting remote employees is a trend which will be the future management strategy. Famous business web portal "www.busness.com" published an article on the importance of virtual office they focused on five causes to select virtual office strategy [18]. The article summarized that virtual management could improve the productivity of employees, reduce office space, it can reduce office setup and furniture cost, it can increase business flexibility and easy to marketing in e-market. Another business blogs website "www.business2community.com" published a blog which describes the efficiency of virtual management over traditional management [19]. The author points out three major issues of virtual management that it is cost-effective, the virtual office has a relaxed job environment, and it consists of technology. Virtual office being used by developed country vastly but it requires a new management technique to make the system useful. Lots of research work available on the internet which related to managing the virtual workforce. It proves that now a day's virtual workforces are no more virtual, they have become a reality and being used, so it

needs to learn the way to manage and use the virtual working environment to get proper efficiency. Karvonen I. et al. described the changes to manage such organization which has the virtual workforce and virtual management [20]. Virtual organizations (VOs) are viewed as a response to fixing necessities of cost-adequacy, time and quality, particularly in a worldwide aspect. During developing a virtual industry working model, the developer has to consider about the three terms, properly distributed, depend, and coordinate among tasks and employees. Virtual industrial management has been identified as the most suitable management strategy in current technology-based management. An article by JJ Murphy says that conventional management is failing to accumulate employees from the global environment [20]. The virtual hierarchical administration is the required change in the administration worldview. Some specialist contended that traditional industrial management system is not efficient enough as much as the cutting edge virtual workplace. In 2008, European council of modeling and simulation (ECMS) arranged a conference where a paper concentrated on the use of Virtual Reality (VR) advancements and Virtual Environments (VEs) on the modern industrial safety issue [21]. Due to less physical participation, the virtual working environment is safer than the traditional working environment. World most reputed business magazine "Forbes" published an article which discovered that virtual working environment increases the productivity of employees [22]. From an overview of a Chinese organization, it was discovered that the virtual workforce was 13% more profitable, more joyful in their employment and more averse to leave than their office-bound companions. The article also points outs some limitation of virtual management which has also been discussed in this work later. The size of the organization is very crucial in a physical working environment. In this case, the virtual working environment has the flexibility to adopt a large number of workers as it does not require the physical extension. An article from the famous community of professionals people "LinkedIn" by Dr. Sreekumar Menon says that the progress of information and communication technology introduced change in business characteristics [23]. Beforehand, business was viewed as shut when the workplace entryway was 'shut.' However, nowadays, employees can work all the time from their home or any location by connecting with laptop or smartphone. It is evident the virtual working environment, virtual team and virtual management have a lower cost than the physical model. Virtual management is efficient due to fast communication. Also, it has the flexibility to add a

worker from any geographic location to work. Even a large number of the worker could be assigned to the same system at the same cost. Virtual management seems very efficient and cost-effective, but it has some challenges. In this case, the challenges should be overcome because virtualized management is the future of common management. To design a virtual system, it is a significant factor that, the system should have enough monitoring option and bindings for the managerial user that they can play their vital role to run the system without losing enough monitoring. PETER F. DRUCKER mentioned in his book "Management Challenges of 21st Century" (1999) that information management is one big challenge in modern management [24]. Due to the requirement of large data processing, there have a tool named management information system (MIS). MIS also requires manual data entry for processing, but the virtualized management can make it more automated as all the processing will be in the computerized system. Virtual groups empower associations to pool the abilities and skill of workers and non-representatives by taking out time and space obstructions. Nowadays companies are investing the significant amount for virtualized employment to enhance their performance and competitiveness [25]. The accessibility of an adaptable and configurable base framework is one of the key points of interest of nimble virtual groups. Over the previous decade, associations have progressively moved toward enlisting a more virtual workforce. Discoveries from the 2010 Cisco Connected Technology world report, the quantity of organizations receiving a more synergistic virtual workspace is on the ascent, furthermore, the projections imply an expanding development rate toward that path [26]. An article on some virtual team management/project management discovered the problem of existing software models [27]. Most of them have some limitation like that software developed from a commercial aspect, so it needs a good amount of money, the software's can't work with all type of organization to perform their operation in the virtual world, follow the virtual instruction. The virtual organization works based on a software system which provides some notification in software to do some task, as this notification has no physical shape so the user might be miss task order. To develop a new efficient model, these three factors should be considered, and the proposed model was developed. An inventor name Brian Conner patent a virtual office management system [28]. He gives an easy to understand three-dimensional Graphical User Interface (GUI) for exploring inside a virtual office condition for undertaking and data manipulation. Nader et al. reviewed the virtual teams and management issue [29].

Results indicated that small and medium enterprises (SMEs) can be benefited significantly when they work within the virtual teams and management systems.

Despite the virtual office system or entire virtual organization is not vastly available in our country due to some fundamental reasons like the lag of technology, the high price of software to operate and implement virtual organization. To apply virtual management inside under developing countries, the thesis work has been proceeded to develop low-cost free software to implement virtual industry.

2.2 Some Existing Project Management Software and their pros and cons

There has some similar method to manage industrial operation which is known to us as "Virtual Office," and it has been used for a long time of modern industrial management [30-39]. Over that existing system, the new model has some key difference. The existing software is developed for specific purpose and are not applicable to all type of organizations. Whereas the "Virtual Industry Model" is an integrated module that has everything inside a package and are applicable to almost all type of organizations. Moreover, the other thing is all of existing software requires a good amount of money to use, so those are commercial tools and not free for everyone. In countries like "Bangladesh," it is not possible to use highly paid software for every type of industry where the virtual industry model open for all.

Table2.1 is showing a comparative analysis between conventional software and proposed "Virtual Industry Model" software. There is much virtual organization management software but due to their specific limitations this thesis work performed and a tool has been developed to overcome the limitations.

Table 2.1: Comparative chart between conventional software and Virtual Industry management software

Factor	Conventional virtual office Software [31-40]	Proposed Virtual Industry management software
Price	Most of conventional software has a high price, that's why people get discouraged to use highly paid software.	Virtual Industry Model Will be a freeware to use, it will be opened for all to use without any payment.
Application	Not Applicable for all	Global platform for all type of organizations.

Sector	type of organizations, most of them are specialized for software industry or specific industry	
Functionalities	Limited functionality, need several software to perform as a virtual organization	Virtual industry model has several functionalities in a single software, it is an integrated system
User Friendly	More difficult to use for general user.	Easy user interface and user friendly to use.
Hardware Requirements	Conventional system requires many network devices.	The system needs only internet connection and a general computer. It is accessible from any location using internet so it requires very less hardware.
Upgrade and Maintenance	Conventional system requires high payment to upgrade. It is also difficult to maintain due to large network environment.	Virtual industry model will be a freeware and open source software so users will be able to upgrade the system by changing its code according to their requirements. It only requires internet connectivity but not a complex LAN/WAN network. Now a days, managing a LAN is much expensive than have an internet connection.

CHAPTER III

Development Process of Virtual Industry Model Software

In this chapter software development process is described.

3.1 Elements of the proposed Virtual Industry Model

The elements of an industry shown in Fig. 3.1. The major three elements like clients, virtual office and physical production are have been synchronized in this model. The elements have been selected based on a typical business organization by random selection. As the proposed model is being developed as a global communication system, organizations with different elements could be converted as a virtual organization using the proposed system. The elements of this virtual industry model are briefly described below.
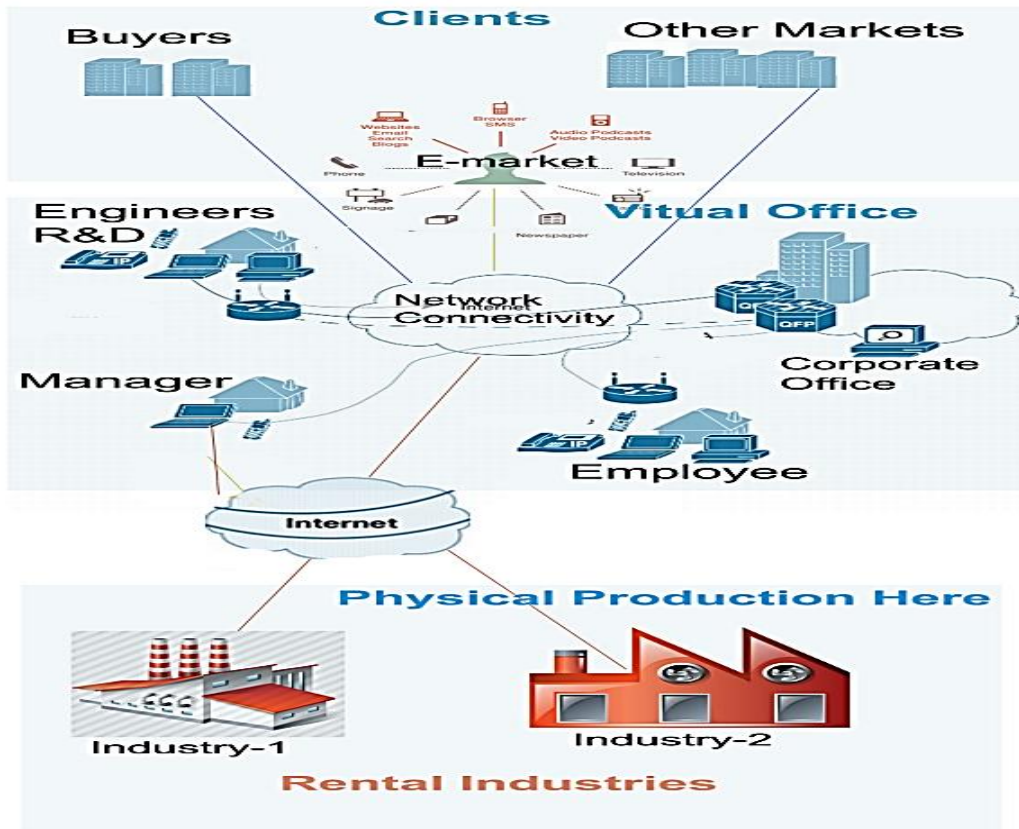
Figure 3.1: The Virtual Industry Model block diagram

3.1.1 Clients

Clients are the consumer of products or service for whom industry produces something. For an industry, most of the case clients are buyer groups/companies from the local or foreign market (export). In this proposed model, online customers are a big market. Buyers will be able to access and order directly from their place via "Virtual office software," the software will count, calculate the production plan from some given inputs from clients and managers.

3.1.2 Virtual office segment

Virtual office segment is the focal point and backbone to establish a virtual industry. Virtual office, which exists only in cyberspace, is a business location and workplace. A virtual office setup permits entrepreneurs and representatives to work from any area by utilizing technology, for example, smartphones, telephones, and web. The virtual office can give savings and adaptability contrasted with leasing physical office space. People can gather remotely, coordinate through video conferencing and reports can be transmitted using information and communication technology. Everybody in this model is free to work from any place, but they have to complete their tasks as per given time and deadline. So the system will help to ensure the optimal use of human resource. The figure3.1 is showing that all the employees are working at their home by connecting a shared network and software system that has been developed in this proposed model. The virtual office needs only a single room to set up some technical equipment. Managers and owner of the industry can monitor the whole working process from anywhere around the world. A web-based application has been developed which will fulfill the coordination between all elements of the virtual industry model.

3.1.3 Managers

Managers are the key persons for the industry to manage the man, machine material in industry. Though this model skips, physical workplace manager will play the key role in this model. He will organize and synchronize among all part. This model will make it very easy for the manager as he is going to perform any task, monitor the progress using software and other tools.

3.1.4 Engineers (R&D)

In this model, the industry or company does not need to hire a full-time engineer to perform research and development. An industry/company can hire part-time expertise, for that the salary-related cost will be reduced. As it will reduce cost, the entrepreneur can hire several part-time experts.

3.1.5 Employee

An industry needs different employees for the different purpose, for example, accounts, marketing, advertising, etc. All of such employees will also work through a network accessing the virtual industry software system and complete their assign task without any delay. In this system, there are no opportunities to claim wages without working because of the virtual software.

3.1.6 Network Connectivity

For developing this software, first needs to have fast network connectivity to connect all the functional blocks. The system can use the internet, mobile networks, and other fast internet services for connecting remote human resources to log in to the software and work. Internet will be used to communicate with employees, clients and rental industry via virtual office software, and If the industry locates near the virtual office network area, it can use LAN. Because it needs high speed fulltime network to observe, communicate and monitor that industry's working progress due to virtual industry's order. The functional blocks that shown in figure3.1 are connected through the various networks, this is very important in the proposed model.

3.1.7 Rental Industries

The contract, rent, and leasing are the common terms in the industrial production system. Many companies use rental or leasing industries and factories to produce their product. For example, world-famous brands like "Nike" which has no own factory to produce their branded shoes. There are lots of companies they use their brand but produce from different factories basis of the contract. In this model, it was emphasized on the rental factory. Because acquiring factory space, machinery, land and other setup is the main cost that is an obstacle for an entrepreneur to establish an industry. Also maintaining and operating cost is high for a real industry whereas, this proposed model reduces this cost. It needs to make good connectivity on the virtual software system. By using this virtual industry model, it is possible to plan for

producing several products as industry wish, because the industry can contract with any factories in the local or foreign region for their any product. This gives "Virtual Industry" model versatility of production planning.

3.2 Development process of "Virtual Office" software

The development process is done by following some steps that shown in process flowchart in figure3.2. The first step was selecting appropriate development tools, then design the database, design user interface. After the end of the designing process, it required to hire a skilled software engineer thus the system needed sophisticated programming. The next step was developing the programs modules of the software's and tests the output. Bug fixing process was done until the programs performed according to design. End of bug fixing process, the software was hosted on the web server to make it globally accessible.
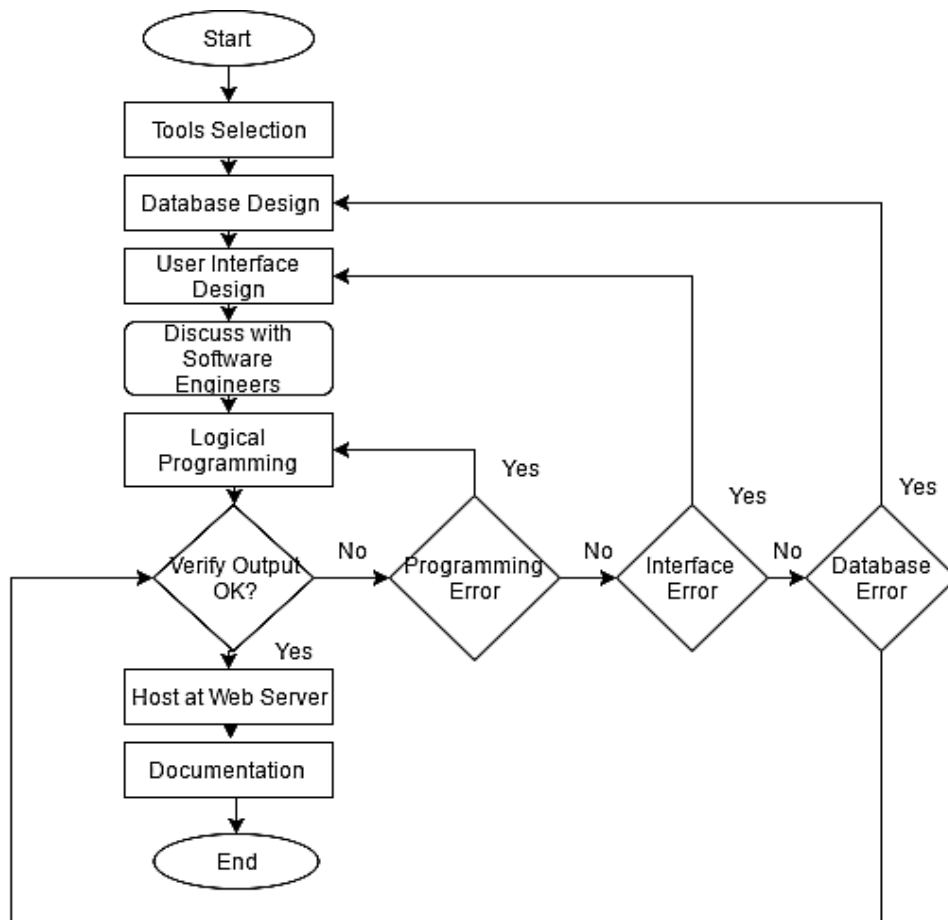
Figure 3.2: Flowchart of virtual office software development process.

3.3 Tools & Technology Used

This model consists of a package of software and communication tools that will make an environment of an industry like the traditional industry in the virtual/cyber world. First of all, it needs strong online database based software where all types of processing will be done, and input will be taken. Following tools has been used to develop the software:

1. MySQL Database (PHPMyAdmin)
2. Adobe Photoshop for graphical design.
3. HTML, CSS for graphical User Interface design.
4. PHP programming language for logical web programming.
5. Java Script, Jquerry, Ajax for on page functionalities.
6. Apache web server.
7. Notepad++ for edit source code.

3.4 Key Components of Virtual Industry Model Software

In this proposed Industry/office software system has four basic components, they are

1. Database.
2. Web Application (Logical Programming).
3. Web Server.
4. Presentation (GUI)/User Interface.

3.4.1 Database (Entity Relationship Diagram of "Virtual Industry Model" software)

An Entity Relationship Diagram (ERD) also called as the ER Diagram is the graphical illustration database structure, which demonstrates the database in the diagrammatic methodology. Entity Relationship Diagram of Virtual Office software Database is shown in Figure 3.3. And 3.4. There are 17 tables in the database that has been used to develop the virtual industry communication system. All of those data record/tables have an internal relationship to access required information based on the relationship or specific entity. There have four types of relation, they are, (i) one to one, (ii) one to many, (iii) many to one, (iv)

many to many relationships. One to one relationship indicates only one record from a table is associated with another one record of another table. One to many relationship means one record from a table could be connected with multiple record of another table. Similarly, when many records from a table are connected with one record of another table, then the association is many to one. When multiple records of a table are associated with multiple records in another table, then it will create many to many relationship.
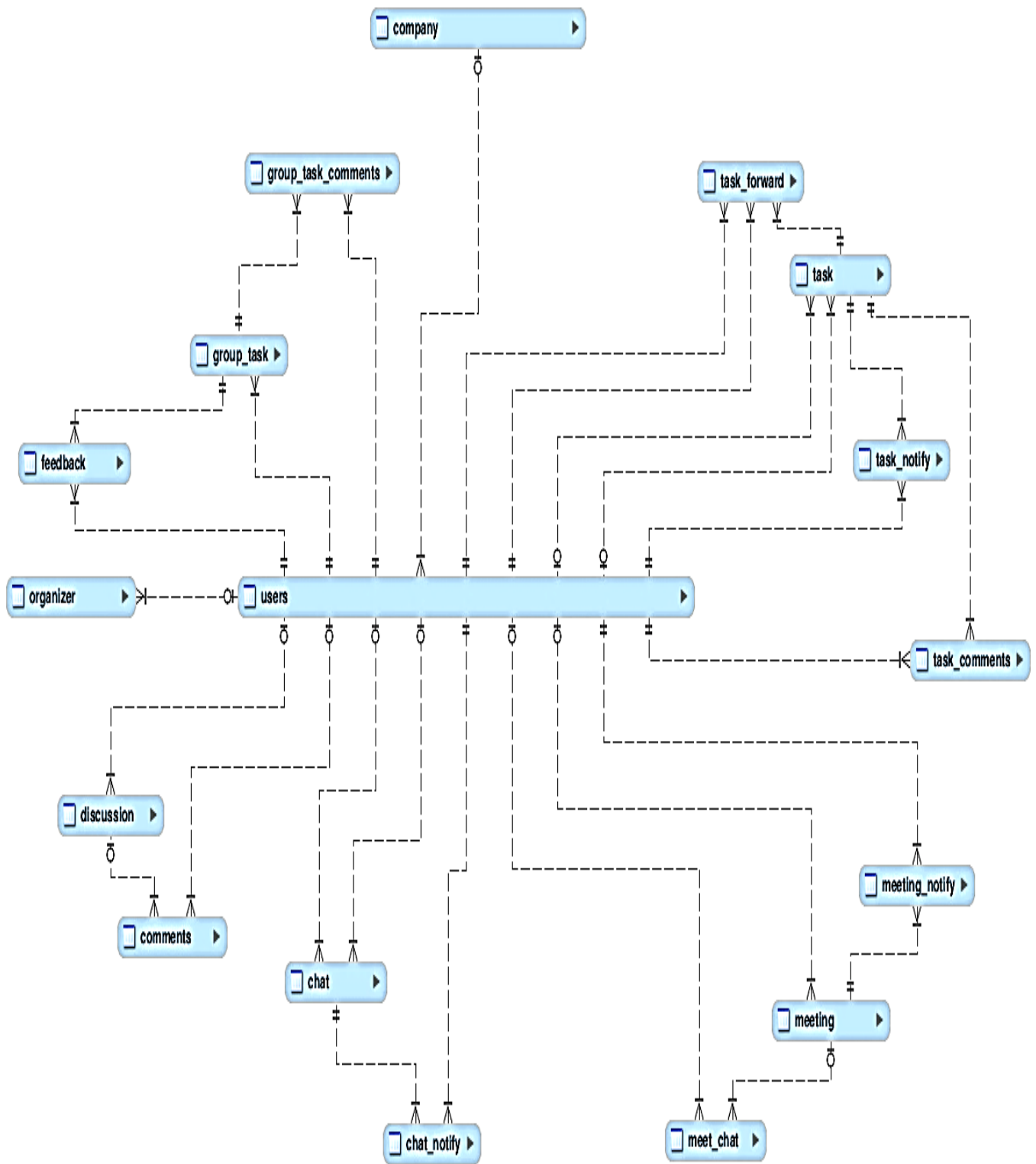
Figure **3.3:** Entity Relationship Diagram of Virtual Office software Database
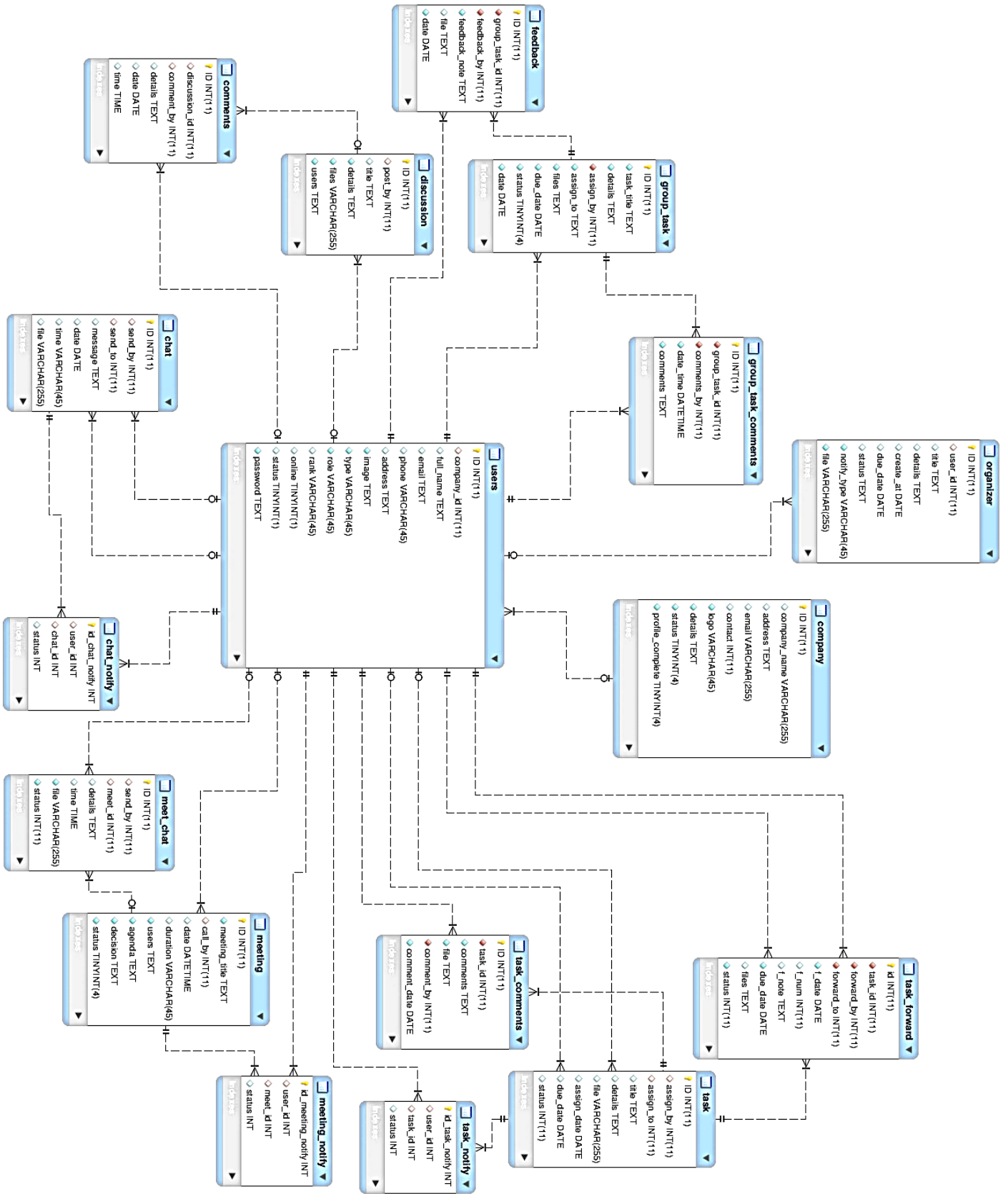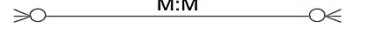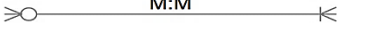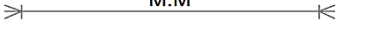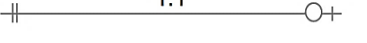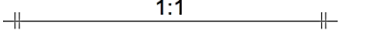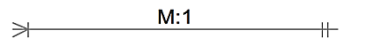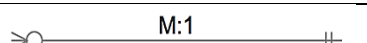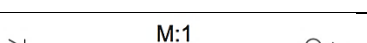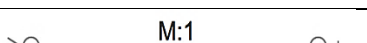
Figure 3.4: Details Entity Relationship Diagram of Virtual Office software Database

Table: 3.1: Entity Relationship Diagram Symbols and Meanings

Symbol	Meaning
+O———————	Indicates One or zero record
>———————	Indicates Many or One record
+|———————	Indicates Only one record
>O———————	Indicates Many or zero record
>O———M:M———O<	Zero or many records associated with zero or many records
>O———M:M———<	Zero or many records associated with one or many records
>———M:M———<	One or many records associated with one or many records
+|———1:1———O+	Only one record associated with zero or one record
+|———1:1———|+	Only one record associated with only one record
>———M:1———|+	One or many records associated with only one record
>O———M:1———|+	Zero or many records associated with only one record
>———M:1———O+	One or many records associated with zero or one record
>O———M:1———O+	Zero or many records associated with zero or one record

3.4.2 Description of Tables in Database:

Table: 3.2: Used Data Types and their description

Data Type Name	Size/Range	Description
INT	11 Digit, Signed Range: -2147483648 to 2147483647, Unsigned range: 0 to 4294967295	Integer type data

TINYINT	4 digits, Signed range: -128 to 127, Unsigned range: 0 to 255	4 digit integer type data
DATE	1000-01-01 and 9999-12-31	Stores value of date in "YYYY-MM-DD" this format
DATETIME	1000-01-01 00:00:00 to 9999-12-31 23:59:59	Combined date and time, format: YYYY-MM-DD HH:MM:SS
TIME	00:00:00 to 23:59:59	Stores data regarding time, format: HH:MM:SS
VARCHAR	1 to 255 characters	Stores characters
TEXT	1 to maximum 65535 characters	Stores large number of charter

3.4.3 Tables in Database and their entity description

Table Name: User

Relationship: This table contains the login information. All the tables has a relationship with this table. Usually the relation is one to zero/one or many. To manipulate data from any table, it is essential to identify the user's information, which is stored at this table.

Description:

It is the main table in the database. It will store all employee information as user. Every employee who has a role in management he will register as a user in the system. Company administrative staff will login as company admin and the rest will login as user. Each user type has specific permission level to perform several tasks. Administrative user will be able to monitor the all data of any company but general user has limited access. To create difference between user categories there have some data fields in the "User" table, the description of each field given bellow:

Fields (Data Type):

- **ID INT(11):**This entity is a integer type field, it increase automatically with each entry. It will be used as primary key to identify an user uniquely to relating with other tables and record keeping.

- **company_id INT(11):** Every company will be identify using an integer number in back end. This field will store the company identification number of user/employee.

- **full_name TEXT:** Text type data, simply the full name of user. This name will be displayed to everywhere in presentation layer to other user.

- **email TEXT:** In this field, system will stored a valid email address of user, using this email address it will send notification, password retrieving option.

- **phone VARCHAR(45):** The phone number is a vital information of any employee inside an organization. In this field it will store the phone number. This number will be given to other for voice calling, also it could be used it for messaging in the software.

- **address TEXT:** This field will store address related information. It is a text type field.

- **image TEXT:** In the software, a photograph of user will be shown in his dashboard, that image also will be used to other for his visual identity. Normally the system will upload those images into a folder but this field will store the related image location address of user.

- **type VARCHAR(45):** As the users are classified according to their management role in organization. This field will store the type of user. Like company admin, super admin or employee.

- **role VARCHAR(45):** Role is user responsibility type

- **rank VARCHAR(45)**: Stores the performance evaluation information as star mark.

- **online TINYINT(1):** This field will store the status of user that is he in online or not. When user logon to the system it setup to "1" else "0"

- **status TINYINT(1):** If the status is set as "1" then user will be able to access the system if the value "0" user will not be able to access the system. Super administrator set the value from his control module.

- **password TEXT:** Contains the password to secure the system.

Table Name: Company

Relationship: The table "company" has a relationship with table "user". The relation is one to many relationship, because a single company may have one or more users.

Description:

- ID INT(11): This entity is a integer type field, it increase automatically with each entry. It will be used as primary key to identify an user uniquely to relating with other tables and record keeping.

- company_name VARCHAR(255): This field carry the name of the company.

- address TEXT: Stores the company address

- email VARCHAR(255) : This entity stores the email address which will be used to login or company administrator's username.

- contact INT(11): Company contact information.

- logo VARCHAR(45): This field stores the image location link of the company logo.

- details TEXT : details of the company

- status TINYINT(4): Is company approved by admin, if approved then th value will be "1" else it will store "0" value.

- profile_complete TINYINT(4): Is company Profile complete. If not system will notify the company admin to complete the profile.

Table Name: task

Relationship: The table "task" has relation with multiple tables. First the table associated with table "user", the respective user who will assign the task and to whom it will be assigned that is associated. It as one to many relationship with table "task_comments". The table also associated with table "task_notify" and table "task_forward".

Description:

- ID INT(11): It is the primary key to identify task number. The value of this entity increase automatically during the entry of each record.

- assign_by INT(11): Information of the user who created and assign task to another user.

- assign_to INT(11): Information of the user who is responsible to finish the task.

- title TEXT: Task title is heading of the task.

- details TEXT: Task details is description of the task.

- file VARCHAR(255): This entity stores the task related file location URL
- assign_date DATE: Assign date actually task created date.
- due_date DATE: This date is task deadline.
- status INT(11): Is task complete or not.

Table Name: task_forward

Relationship: The table "task_forward" associated with two tables. It has multiple on-to-many relationship with the table "user" because it has to connect with two records from the "user" table. At least one user's record is required to assign a task and another user's record to be responsible for the task. The table also has a many-to-one relationship with table "task". Basically when a job needs to be forwarded to another user then the information will be stored at table "task_forward"

Entity Description:

- id INT(11): The primary key of this table, value of this entity increase automatically with each record.
- task_id INT(11): Stores the value of initial "id" created before forwarding.
- forward_by INT(11): Stores value of user identity who forwarded the task.
- forward_to INT(11): Stores the value of user who will responsible to complete the task.
- f_date DATE : Forward date
- f_num INT(11): How many times forwarded the task.
- f_note TEXT: Stores additional information provided by while forwarding task.
- due_date DATE: Contains the value as a date, when the task should be done.
- files TEXT: Stores the URL link of regarding file with the task.
- status INT(11): Stores an integer value to identify the job status, if the value is "1" then it will be identified as a finished task, else not finished.

Table Name: task_comments

Entity Relationship: This table has one-to-many association with table "task". Many comments record could be stored at one task. And the table also has one-to-many relationship with table "user" because the respective user identification should be recorded with each comment.

Entity Description:

- ID INT(11): Identify task comments and its serial using this field. This entity is a integer type field, it increase automatically with each entry.

- ttask_id INT(11): Stores the value of respective task identity.

- comments TEXT: Contains the characters of comment.

- file TEXT: URL of respective file will be stored here if any file attached.

- comment_by INT(11): Stores the user id number who will make the comment.

- comment_date DATE: Stores comment date.

Table Name: task_notify

Entity Relationship: The table has one-to-many relationship with table "user and table "task"

Entity Description:

- id_task_notify INT: Notification id. This entity is a integer type field, it increase automatically with each entry.

- user_id INT: Stores the user identification value.

- task_id INT: Stores the task identification value.

- status INT: After each task creation the value will set as "0" after the user checking status will change from 0 to 1, which identify that the notification has been seen.

Table Name: meeting_notify

Entity Relationship: The table has one-to-many relationship with table "user and table "meeting"

Entity Description:

- id_meeting_notify INT: Notification id. This entity is a integer type field, it increase automatically with each entry.

- user_id INT: Identification number of respective user of a meeting.

- meet_id INT: Contains meeting identification number. With this id, notified user can get meeting information like date, time etc.
- status INT: Stores a integer type value that indicates the meeting status, during creation of new meeting call the value set as "0" and when the time match with meeting holding time the value set as "1"

Table Name: meeting

Entity Relationship: The table has many-to-one relationship with table "user". Also associated with table "meeting_notify" and table "meet_chat" as one-to-many relationship.

Entity Description:

- ID INT(11): It contains a integer value which increase automatically with each entry. This entity is the primary key to connect with this table.
- meeting_title TEXT: Stores the title of the meeting.
- call_by INT(11): Stores the name of the user who called the meeting.
- date DATETIME: Contains the date and time value when the meeting will be held.
- duration VARCHAR(45): It contains a value that will be used to show a time counter.
- users TEXT: Users who assigned/invited for the meeting.
- agenda TEXT: Meeting called to discuss about these tropic/agenda/subject.
- decision TEXT: Meeting decision will store in this field.
- status TINYINT(4): Contains a integer value to identify meeting status .

Table Name: meet_chat

Entity Relationship: The table "meet_chat" has many-to-one relationship with table "meeting" and "user"

Entity Description:

- ID INT(11): This entity is a integer type field, it increase automatically with each entry. It will be used as primary key to identify a chat message which is send within meeting chat.

- send_by INT(11): Contains the information of the user who send message for other member within the meeting.
- meet_id INT(11): Stores the identification number or respective meeting.
- Time TIME : Stores the time during the message.
- file VARCHAR(255): Stores URL link regarding any file that will be send through message.

Table Name: chat_notify

Entity Relationship: The table associated with table "chat" and table "user". The relationship is many-to-one, because several notifications could be generate for a chat session.

Entity Description:

- id_chat_notify INT: Primary key, this entity is a integer type field, it increase automatically with each entry.
- user_id INT: Stores the identification number of number of respective user.
- chat_id INT: Chat message id which send to the user.
- status INT: Contains an integer value, default value is "0", when the use see the message status will change from 0 to 1.

Table Name: chat

Entity Relationship: The table contains the information regarding message send and receiving between two users. It has many-to-one relationship with table "user" and one-to-many relationship with table "chat_notify".

Entity Description:

- ID INT(11): This entity is a integer type field, it increase automatically with each entry. It will be used as primary key to identify a chat message.
- send_by INT(11): Contains the value of sender user's identification.
- send_to INT(11): Contains the value of receiver user's identification.
- message TEXT: All the characters of the message will stored into this entity.
- date DATE: Stores the value of date of each message during creation of the record.

- time VARCHAR(45): Stores the value of time of each message during creation of the record.
- file VARCHAR(255): Contains the URL link if any message has any attached file.

Table Name: discussion

Entity Relationship: The table has multiple many-to-one relationship with table "user" and one-to-may relationship with table "comments".

Entity Description:

- ID INT(11): This entity is a integer type field, it increase automatically with each entry. It will be used as primary key to identify a discussion/post.
- post_by INT(11): Stores the user identification value.
- title TEXT: Contains the post title character.
- details TEXT: Post details which will main content of the post
- files VARCHAR(255): URL link of the post file/image which will relate with the post
- users TEXT: Contains the associated users identification number with the discussion.

Table Name: comments

Entity Relationship: The table "comments" contains the data related with discussion among users. It has many-to-one relationship with table "user" and table "discussion"

Entity Description:

- ID INT(11): Primary key of the table. This entity is a integer type field, it increase automatically with each entry. It will be used as primary key to identify a discussion/post comment.
- discussion_id INT(11): Contains the discussion identification value.
- comment_by INT(11): Stores the identification value of the user who makes the comment.
- details TEXT: Contains the details characters of the comment.
- date DATE: Comment date
- time TIME: Comment Time

Table Name: feedback

Entity Relationship: The table has many-to-one relationship with table "user" and table "group_task".

- ID INT(11): This entity is a integer type field, it increase automatically with each entry. It will be used as primary key to identify a group task feedback.
- group_task_id INT(11): Contains the associated group task identity number.
- feedback_by INT(11): Contains user identification number who submitted the feedback..
- feedback_note TEXT: A short note while submit
- file TEXT: URL link of the any attached file with task feedback.
- date DATE: Submission date

Table Name: group_task

Entity Relationship: The table has many-to-one relationship with table "users" and "group_task_comment". The table also associated with table "feedback" in one-to-many relationship.

Entity Description:

- ID INT(11): This entity is a integer type field, it increase automatically with each entry. It will be used as primary key to identify a group task.
- task_title TEXT: group task heading.
- details TEXT: task details for particular group task
- assign_by INT(11): Who create the group task
- assign_to TEXT: Who is responsible to complete the task
- files TEXT: URL link if necessary file will provide while create group task
- due_date DATE: Contains task finishing deadline.
- status TINYINT(4): Stores a default value "0" as the task is not finished, when it will be set as done then the value will be "1"
- date DATE: Group task create date

Table Name: gropup_task_comments

Entity Relationship: The table associated with table "users" and table "group_task" in many-to-one relationship.

Entity Description:

- ID INT(11): This entity is a integer type field, it increase automatically with each entry. It will be used as primary key to identify a group task comment.
- group_task_id INT(11): This entity stores task identification number.
- comments_by INT(11): Contains the respective user identity.
- date_time DATETIME: comment date and time
- comments TEXT: comments text

Table Name: organizer

Entity Relationship: This table has many-to-one relationship with table "users"

Entity Description:

- ID INT(11): Used to uniquely identify organizer. This entity is the primary key and the value increase automatically.
- user_id INT(11): Respective user identification number.
- title TEXT: organizer title
- details TEXT: organizer details
- create_at DATE: organizer which created on the date
- due_date DATE: deadline of organizer
- status TEXT: is complete or not
- notify_type VARCHAR(45): What kind of notification user want while organizer deadline on date or expire.
- file VARCHAR(255): Necessary file for particular organizer

3.5 Algorithms of Major Modules

1. **User Login Module Algorithm**

Setp-1: Start;

Step-2: Get input user_name & password;

Connect with database and select table "users", get data;

if (user= unregistered then go to step-4);

Step-3: Connect with database and select table "users", get data;

If (user_name & password=table[users]_user_name & table[users]_password)

{ Output page "User_ dashboard" ;

set field "online" value=1, Go to Step-6;}

else {Output message "Invalid login or user not exist", go to step-2;}

Step-4: Get input=user name, email, password, organization_name,

Connect Database, select table "company", get data;

If(unregistered organization then go step-5)

Connect Database, select table "users", get data;

If(email=table[users]_email)

{output message " Email Already Exist" and go to step-4}

Else { Connect table "users" insert data and set status=0, role=user, go to step-6}

Step-5: Get input= organization_name, Admin name, email, password;

Connect Database, select table "users", get data;

If(email=table[users]_email)

{output message " Email Already Exist" and go to step-5}

Else {Connect table "users" insert data and set status=0;

Set role=c_admi /company_admin

Connect table "company" insert data and set status=0;

}

Step-6: End;

2. Algorithm of Virtual Workspace Dashboard for Different types of User

Step-1: Start

Step-2: Get input user_email and login approval from user_login page;

Step-3: Connect to database, select table "user" get user_role=table[user]_role;

Step-4: if (user_role=c_admin)

{

Get company_id and select table "company" ;

Retrieve company information where table[company]_id= user_company_id print info;

Get task information from table "task" using user_id and output task details;

Get organization's employee infor using user_id & company_id, output employee rank

Select notification tables using user_id and print all notification;

Print all functional menu & go to step-5;

}

Else if(user_role=user)

{

Get company_id and select table "company" ;

Print all company users information;

Get task information from table "task" using user_id and output task details;

Select table "organizer" using user_id and print all upcoming events;

Select notification tables using user_id and print all notification;

Select table "meeting" using company_id and print meeting information;

Print all functional menu & go to step-5;

}

Else if (user_role="s_admin")

{

Select table "company" and print all organization's information as a list;

Get company status and print active/inactive toggle option;

Print all functional menu;

}

Step-5: End;

3. **Algorithm of New Job creation**

Step-1: Start;

Step-2: Get input=job_title, job_details, respective_user, due_date

Step-3: If (job_title or job_details or respective_user or due_date !=0)

          {

                Connect database, select table "task" insert data;

                Select table "task_notify" insert data & update notification for respective user;

                If (Attach_file=TRUE)

                 { Upload file to directory;

                   Select table "task" insert file URL link ;

                 }

          Else{ Print Error Message & Go to step-2;}

Step-4: End;

4. Algorithm for Job listing & Status Tracking

Step-1: Start;

Step-2: Get input=user_id;

Step-3: Connect Database select table "task"

        Get task information array;

        If (Task_assigned_by=user_id)

        { Select all task where Task_assigned_by=user_id;

             If (task_status = 0 or 1)

             { SHORT (Task_id) as descending; (FIFO)

      Print the task list assigned by user id status=0 as pending , if status=1 as working;}

       If (task_status = 2)

     { SHORT (Task_id) as descending; (FIFO)

     Print the task list assigned by user as done;}

     }

        If (Task_assigned_to=user_id)

        { Select all task where Task_assigned_to=user_id;

             If (task_status = 0 or 1)

             { SHORT (Task_id) as descending; (FIFO)

      Print the task list assigned by user id status=0 as pending , if status=1 as working;}

If (task_status = 2)

    { SHORT (Task_id) as descending; (FIFO)

    Print the task list assigned to user as done;}

    }

Step-4: End;

5. Algorithm of Virtual Meeting Module

Step-1: Start:

Step-2: Get input=Metting_date_time, Title, Agenda, users list

Step-3: if (Metting_date_time or Title or Agenda or users list=0)

        { Print Error Message! Go to Step-2;}

    Else

    {

    Connect Database, select table "meeting" insert data;

    Select table "meeting_notify" insert data and update notification;

    While (Current_date_time !=Metting_date_time)

        { start down counting and print remaining time to all respective users}

    If (Current_date_time =Metting_date_time)

    { Enable metting Link URL;}

    }

Step-4: End;

6. Algorithm foe Creating Meeting Resolution

Step-1: Start;

Steop-2: Get input=user_id;

Step-3: Connect database, select table "meeting"

Step-4: IF (table[meeting]_status=1)

    { Select all data from table "meeting" where call_by=user_id or users=user_id;

Output users list, agenda, meeting discussion and decision;

}

Step-5: End;

7. Algorithm of the chat module

Step-1: Start;

Step-2: input=user_id;

Step-3: Connect database connect table "company" ;

Step-4: select all users where company=user_id[company];

Select table "users"

If (login_status=1)

{

Print user name with green online mark;}

Else { Print user name with yellow offline mark;}

Step-5: Get user_id=selected user name;

Print messaging text prompt;

Input=message_text;

Select table "chat" and table "Chat_notify";

Update table using user_id;

Step-6: End;

8. Algorithm to Create New Discussion

Step-1: Start;

Step-2: Get input=Title, Details, users;

Step-3: IF (Title or Details or users !=0)

{ Connect Database, select table "Discussion" insert data;

IF (File_Attachement=TRUE)

{ Upload file to directory;

Select table "discussion" insert file link URL;

}}

Else {Go to step-2;}

Step-4: End;

9. Algorithm of the Organizer Module

Step-1: Start;

Step-2: Get input=Title, Details, date, Notify, attachment;

Step-3: IF (Title or Details or date, !=0)

{ Connect Database, select table "organizer" insert data;

IF (File_Attachement=TRUE)

{ Upload file to directory;

Select table "organizer" insert file link URL;

}}

Else {Go to step-2;}

Step-4: End;

10. Algorithm for Organizer listing

Step-1: Start;

Step-2: Get input=user_id;

Step-3: Connect database, select table "organizer"

Step-4: Select all discussing where table[organizer]_user_id=user_id;

SHORT data descending order;

Print the list;

IF (Notify_me=True)

{ Send Email}

Step-5: End;

## 3.6 Flowchart & Description of Deferent Module

1. USER LOGIN MODULE

A flowchart of the user login module is shown in figure 3.5. As the employees will communicate through the "virtual Office" software, so it is required an authentic username and password to differ employees. To start the software, the system will ask employees to provide his user ID and password. If the user doesn't have username or password, he will be asked to register a new user. In this office software model system, unlimited company/industry could be registered, and the list of all those companies will be shown when any employee from any industry will start his registration process. In case of unavailability of his company, he should register his company first because all employees from industry will separately use the system. Management of industries will create a company/industry account. After that, the system administrator will verify the information and approve the company to operate through the virtual office. Rather the system has three different user levels, the system administrator account, company/industry admin account, an employee account. Here only the system account will exist at the initial stage. After the registration process, the company admin will also approve the employee's information after their validity check. When you and your co-worker from the same industry have a company account and employee account, then the industry is ready to perform their tasks. Next step is logging into the system and explore your virtual office dashboard or virtual work-space.

 Role of User

System Administrator: A system administrator, or "system admin," is the individual who is responsible for arrangement, and solid activity of computer network system, especially client-server PCs. In this software there will be one system administrator user to control the access of company user and new organization registration as virtual organization to use the communication system.

Industry/Company Admin: After the system administrator, a company account is the crucial second account. From this account, all employees' account could be controlled. Organization admin will verify the employee account. The performance status and another report will generate here, and only company admin will be allowed to perform monitor and evaluate activities.

Employee/User Account: It is the basic account for all users/employees. From this account, the user will be permitted to perform the task and getting tasks from another user. Submit his work to his supervisor; assign task/job to other users. Share a file or open discussion forum. Organize personal to-do list and other needed functions.
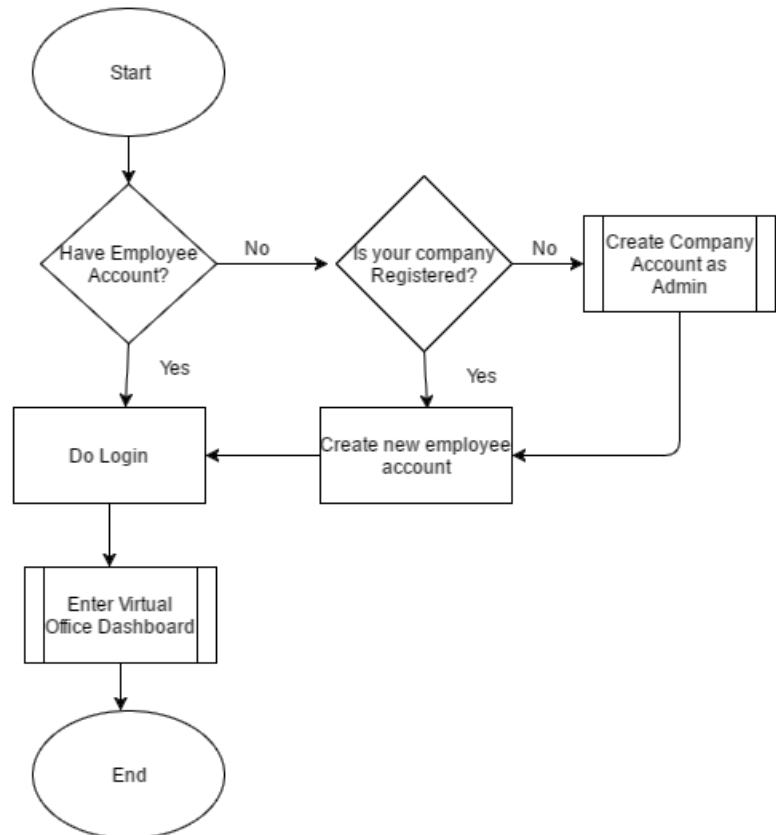
Figure 3.5: Flowchart of user login module.

2. Task/Job management module

Task implies a bit of work to be finished. Task suggests work forced by a man in power or a business or by condition. The virtual office model software has a module to handle the task/job. Inside an industry, the main things to do are several task/job. It is an important duty to do the task of every individual employee. In this model, there has a module which will handle the related task operation. During industrial operation user/employee need to assign a job to other co-workers/employees, whose job has a specific direction, timeline to finish and finally get feedback about task status. If the task/job finished system collect the output from

the related employee. In the model, it has four different blocks to perform these operations. The sub-module of the task is shown in Figure 3.6.

User Task Queue: This sub-module handle the task list, when any co-worker assigned any task, this module store the data into the database. When user login into the system the module retrieve the task queue and short the list according to the deadline. It shows the near time to finish the task and mark them red to green to emphasize on finish the task. The basis on priority industry will set the deadline to finish tasks and module will work based on the deadline.

User Completed Task: When a user will complete any task that was assigned by his management, co-worker and the other inside his industry. That finished task and their details should be documented. In the software, this module will show when the user finished his task. Based on this information employee will be evaluated that how frequent he can finish his job. From the task list, a logical program checks the status of the task that is it done or pending or working. If the task status value shows finished, then that entire task will be displayed to the user.

Task Assigned by User: This module simultaneously records and views the task that user assigned to others. From the list, the user can get an idea about his co-worker and how many tasks of him should be done by others and their deadline. He can start by knocking his subordinate or co-worker about to finish the task.

Completed Tasks Assigned By User: Another finished task list, it shows the finished task by others to any user, that task was assigned by the corresponding user.
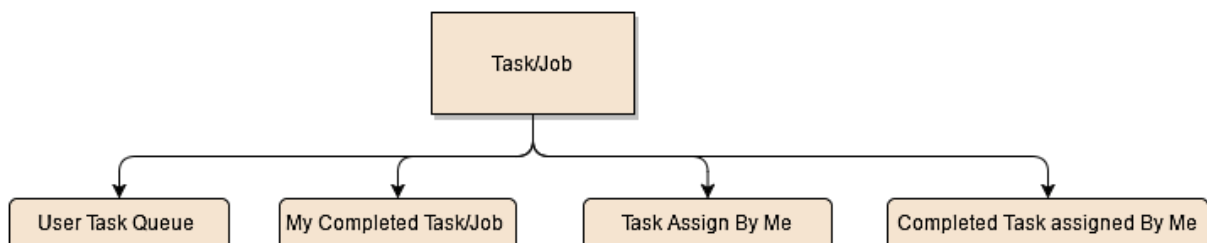
Figure 3.6: Task classification diagram.

3. Flow Chart of New Task/Job Creation Process

Flowchart of task creation process is shown in figure 3.7. To assign any task user has to create a new task. In the software, it has a module that works to process this. Usually, the user needs some information to task submission, those are, what to do? Details of work, who will do? What is the deadline? Attach Necessary file. The system takes this data as input from the user who is assigning a task. If the system does not get all required data, it will notify the user to provide that else system will start searching the company database for the target user who will receive the task. When the system gets the user data, it will insert the task in his queue. Tasks will store and served using FIFO (first in first out) process. The first task will be shown first in the list. The system will also send a notification to other users who were assigned the task about the new task. In the user interface, a user will see a notification icon. The software system also has mail notification, as when user not logged in into the system, he not will be aware of a new task assigned. To solve such case, an email will send with details data of task to the corresponding email address that stored as user's email address.
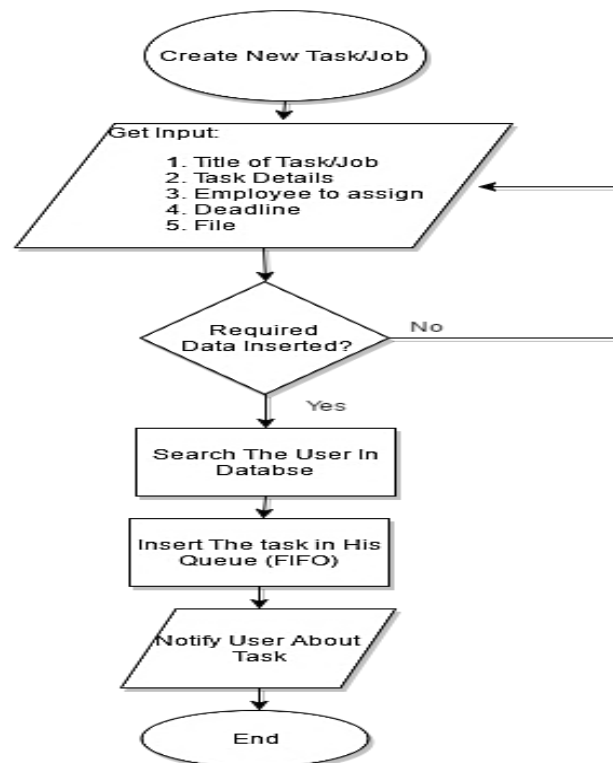
Figure 3.7: Flowchart of New Task Creation Process

4. Task/Job Listing and Shorting Flowchart

The task shorting module shorts the task related database records to identify task progress and status. It finds the newly assigned task that finished or undergoing task and short based on assigning authority. Basically, these processes are done to notify users about their task and remind them to finish and get a clear scenario about his work. As it is mentioned that the virtual industry model will act as industrial management in the virtual world using the virtual office software, so the system has to keep a record about employee's task/job, tracks their task/job. A program read the data from the database and read the status that who assigned the task if the associated user's then it pushes the task into "My assigned Task" list else it pushes it to "Task assigned to Me" list. These two lists indicate which task user has to complete and which he ordered others to complete. Then the program gets the status of the task that is it finished or undergoing. If finished then shows to finished list else push it to the user's to do task list and short them according to deadline also make a notification if the deadline to be ended soon. From the flowchart the system works according to the following steps:
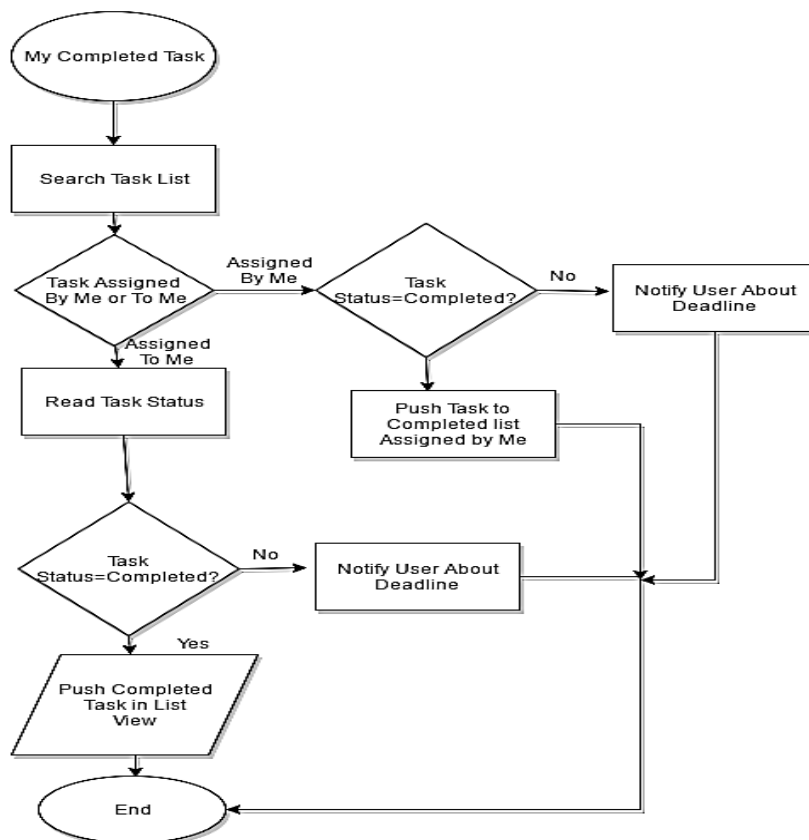
Figure 3.8: Flowchart of Task Listing Module

5. Flowchart of Virtual Meeting Module:

A virtual meeting means that participant of the meeting are connected from different location and not present physically. Using video conference or similar technology, a meeting could be arranged in virtual world like real time. The meeting module is a different module in the total package; it performs the related meeting operation of an industry or any management in the virtual world. So employees don't need a physical space or meet physically for meeting purpose. It is known that meeting is an essential issue in management aspects.

In figure-3.7 the flowchart of virtual meeting module. The module works with several programs that have some functionality to arrange a meeting in the virtual world. From the begging, it takes input from the meeting organizer then notify other users, starts the meeting, monitor and record the discussion then finally save the decision and all data as a regulation. To perform meeting in the virtual world, all employee of an organization have to log in using their username in virtual office software. The program will imitate and ensure those tasks done. The flowchart follows the following steps to work
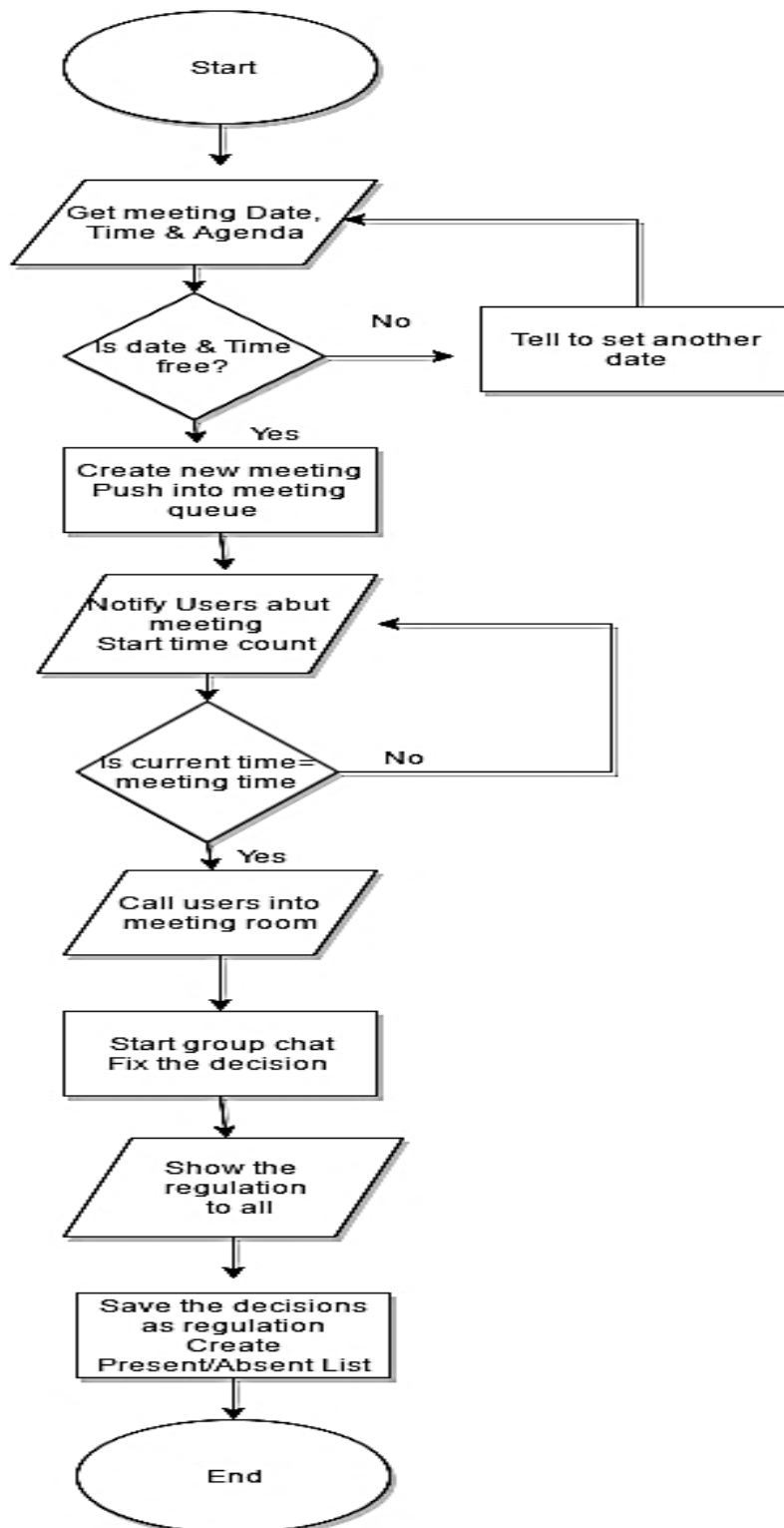
Figure 3.9: Flowchart of Virtual Meeting Module

3.7 Web Server

The virtual office management system is an online communication system which needs to be active always and accessible from any location. To operate such system it requires a server computer where the software will be hosted. Basically this kind of system runs with help of web server. Nowadays, most of organization has their website, those websites are hosted at webserver. If any organization wants to adapt the virtual communication system the can easily integrate the system with their website.

3.8 Presentation (GUI)/User Interface.
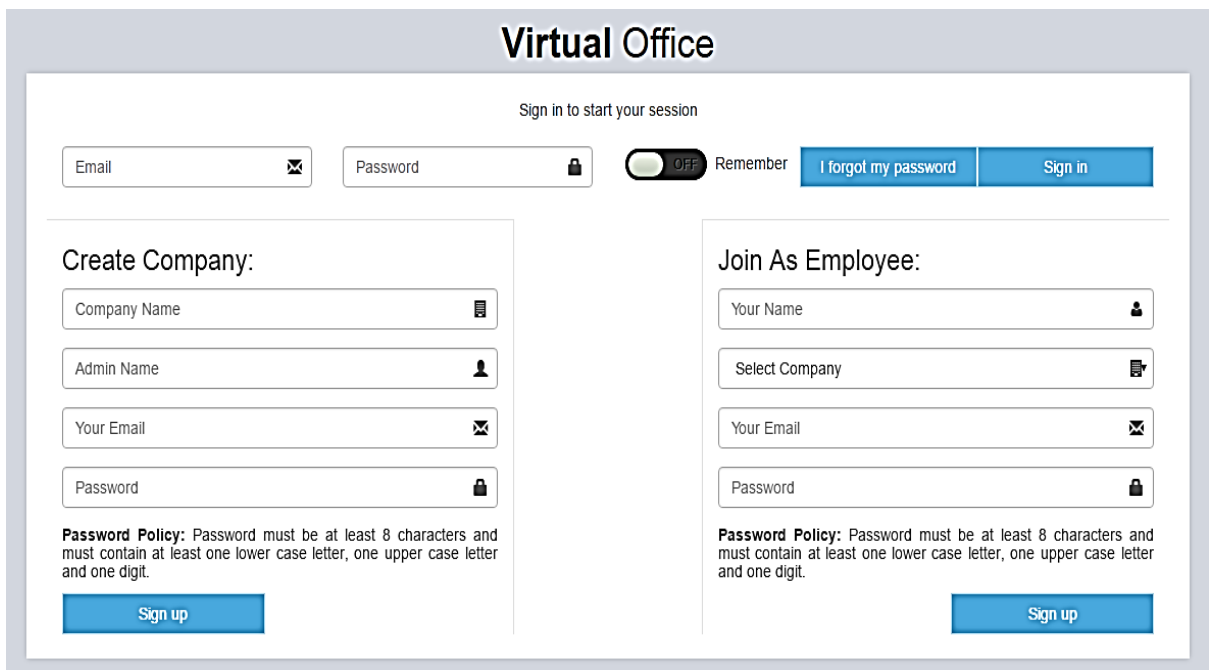
GUI stands for "Graphical User Interface ", the user interface is the output of logical programs. Using the GUI users will interact with the system. It works like a console or control panel. The GUI consists of multiple HTML page and prompts . Popular photo editing software "Adobe Photoshop" has been used to design graphical elements of GUI and HTML, CSS has been used to design the GUI layout. The GUI of different module of this developed software is discussed below.

3.9 Output of the software and operation procedure

3.9.1. Home Page of virtual model software

The system's graphical user interface has been developed using "HTML" and "CSS." The virtual system has a nice and interactive graphical user interface. It is very user-friendly and visually clear to understand the operation. In the home page of the system, the user will see a simple interface where it has four different areas. In the left side on top, it has two data entry field available for user id and password to get access to the software. If the user lost his password, there has a button to retrieve the password. The system has two more data entry options to create a new company account and new user bottom of the page. From there a new company will enter their name, administrator name, email id, and password to start using "virtual office" as a new industry. Similarly, a new employee can start using first time the system from the same page by filling the "Join as New Employee" section's required data. As usual, it has a password recovery option, and if any user forgets his username or password, he

can recover that using the email address that he used during the registration process. When the user clicks the "I forgot my password" button the system sends an email with a recovery link. The user has to log in his email and click on that link, and the link will redirect the system onto a page where he will be able to set his new password. In the cyber world, it is a crucial issue to ensure system security from the hacker. All traditional security option and current security policy have been used in this system that should be available in such a virtual workspace. The system will contain vital information regarding many industries and their management, the employee, their ongoing project. So it has to be a secure system that will have a secure data processing algorithm.

Figure 3.10: User Login interface

3.9.2 Virtual office dashboard/virtual-office-desk:

After login into the virtual office system, the user will be able to work using his interface as like he uses his office desk at the workplace which is shown in figure 3.12. The objective of this work is set up a working environment that employees of any organization can work and connect virtually. According to that, when user login to his account, he will see a working panel having several functional areas as like an office desk with several working staff. It can be defined as a converted working environment from the real world to the virtual. In physical

working space staff opens his room using a key or his cabinet and start working, similarly use a digital key to get access to the working area and start working. The virtual dashboard will show username, his company name, and logo in the top of the window. There has another menu bar where the options will appear. With menu bar, it has a notification icon array which will show the new notifications to the user. If the user gets any new task, a new message, or any co-worker make comments he will get those notifications. In the dashboard, there have three blocks after the menu, one of them is task listing tabs where all task lists will be shown. The next block in dashboard layout is "To-Do" list, and it will show a user what is in his work list today, normally people use smartphone, dairy, whiteboard or note to keep this record. In a virtual office module, the user will be able to keep all of these things in a single screen. The next block is for communicating with co-workers, it will be known as "Chat Panel" all users/employee name list of an industry will be shown here, from the list users will be permitted to send the message each other. In the bottom of the user dashboard in the virtual office, there have two blocks, and one block will show the notice inside an organization, the other one is for sharing personal stuff like a photo, discussion, etc. When the user is invited into a meeting, every respective user will see that meeting notification with a time counter. Inside an industry, sometimes employees do some personal communication for refreshment like gossiping, chatting, discussing a specific topic. To do such an activity, there has a virtual place where the user can post his photo, his feelings or any specific discussion. So it contains all essential functions that required maintaining daily working life inside a physical workplace that is available in newly developed virtual office software which will help us to implement the virtual industry model.
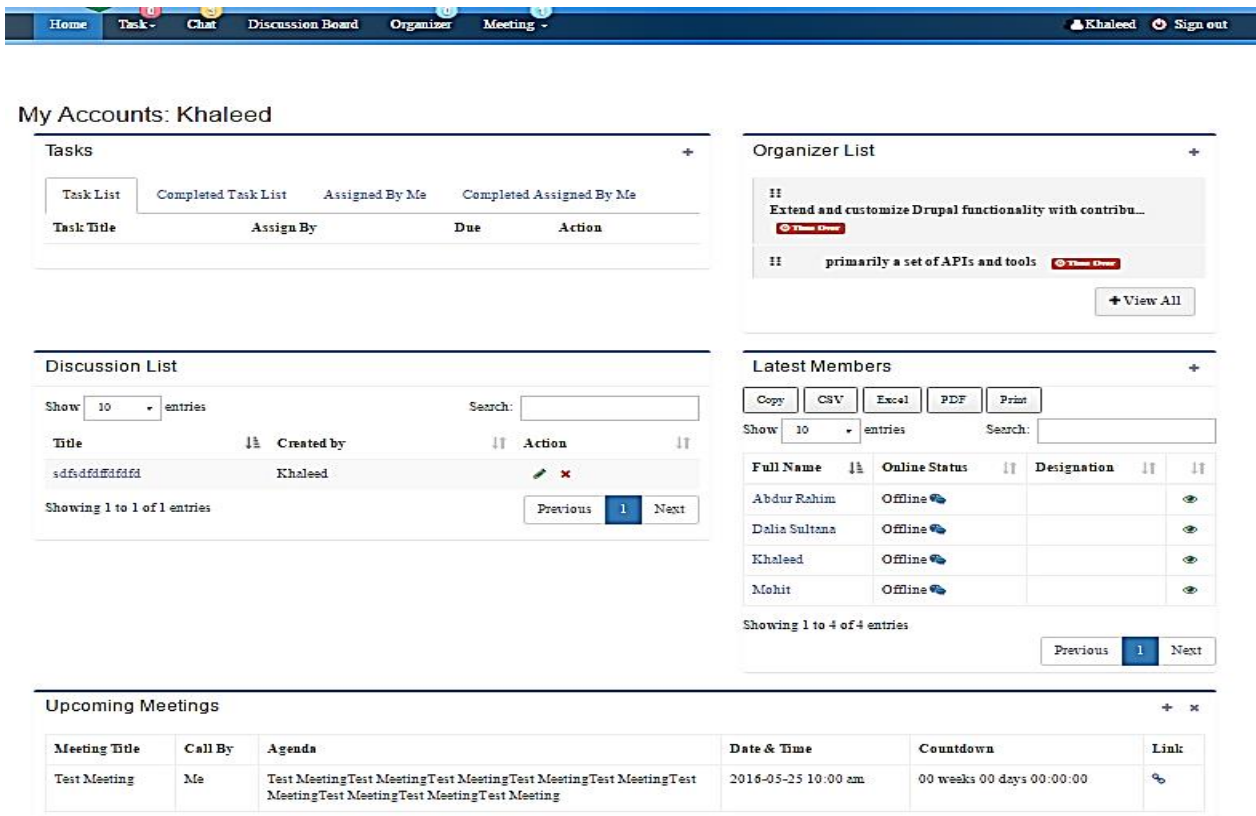
Figure 3.11: Virtual Office Dashboard

3.9.3 Task management interface

There has a page for handling all tasks. This page designed with a very interactive user interface, the user will be able to perform his operation easily without any previous training because of its simplicity. There have four different panels as it is mentioned before in task management flowchart description. In left-top it has a list of task named "My Task List", this list is the queue of tasks that assigned to the user by other. This list has four headings, they are "Title, Assigned By, Day, and Action". The title means a short description of the task, assigned by column show the respective co-worker name who assigned the task. Column "Day" shows the remaining days to finish that job. In column "Action" there has an option list where the user can set the current status that is he is doing the task, or he finished the task. According to his option settings, the corresponding user who assigned the task will be able to track the task status by observing this status option.

Similarly there has another list in the left-bottom side. The list shows the task that assigned my user to his co-workers. This list also has four heading column named "Title, Assigned to, Day, Status". The title stands for the job's short description as mentioned in the previous list. The column "Assigned To" shows the mane of the co-worker who will respond to finish that task. Status column indicates the status the set by the responsible co-worker who is doing the job, if respective worker starts work with the task it will show "Working" if the co-worker didn't start the task it would show "Pending" as task status. In the top of this list there has a button named "Create New Task", by clicking on this button user can go the page for creating the new task. The right side of the page also has two blocks, in right-top there has a list which consists of the finished task name and the co-worker name who assigned. Gradually this list will be long so it would be difficult to show them in a single page, due to the problem there has a page numbering system where only five items will be in a single page, the user will see all tasks in shorted into the page by selecting every page. When it will be huge data then it will become difficult to find any specific task, to solve the problem the software has strong wildcard searching option that can find any of matching task from the large data record.

Figure 3.12: Task management page

3.9.4 New Task Creation Page

The user will use a page to create a new task. Basically, this page will be open as a popup window when the user clicks "Create New Task" button from the main task management panel. From this page, the user will be asked to enter the required data to create a new task. Figure 3.14 is showing a form which will get input to create a new task. It has three text fields. The first one for "Task Title," where the user will enter the specific small details in a sentence that could be understood by the respective person who will do the task. The task title must contain a summarized sentence about the task. The next field is details of the task, in this field user will write down the details about the task, that information should be very clear to understand the job, what to do and the process. The user can write extensive test and other instruction here. These two fields are mandatory to assign a new task/job to others. In the next field, the user will select the user who will do the job, and it is a dropdown list. Name of all employee of an organization will appear on this list. From the list user will select the desired employee name who will be responsible for the job, this is also a mandatory data field. The next field is a file selection and uploading option, using this feature user can send the necessary file that will be used to working on the task/job. Most of the time the employee needs to work with a soft copy of various documents. For example, a civil engineer can send a layout plan of a building to an electrical engineer to work on it for an electrical wiring diagram. In the software, the user will be able to upload any type of file and any size. When the respective user who was assigned the job will open the task, he will see the attachment and will be able to download the file for work. Frequently organizations use a typical mailing system, over the third party mailing system the virtual office has a reliable facility to handle the file. This is not a mandatory option to attach a file, because sometimes some tasks couldn't' have any such file. The final field is the deadline. When the user clicks on the field, a calendar will appear in front of the user, and he will select the date when the task must be finished. In task management and tracking process it is imperative to have a specific deadline.

Figure 3.13: New Task/Job creator

3.9.5 Personal Organizer

Before the finish of the twentieth century, paper-and-cover individual coordinators began to be supplanted by electronic gadgets like individual advanced associates (PDAs), individual data supervisor programming, and online coordinators. This procedure has quickened in the start of the 21st century with the approach of cell phones and tablet PCs and an assortment of portable applications. So it is obvious to us that the organizer is important to keep up every day occupied life proficiently. To make the virtual working environment more efficient, the system has an organizer attached to the virtual office software. When the user goes to the organizer option, he will be shown the user interface in Figure 3.15. There have two blocks in the user page, in the top portion it has the necessary data field to create a new to-do item and save it into the database. To save a new item in the database, the user has to enter the new to-do item's title, details of the item, due date, set its current status, set the notification method and attach the related file. The system used the option "status" to set the item status that it should be done or done. It has another useful function that is if the user wishes he can set email notification method, which will send an email to the user if the user forgets the item in the

organizer. In the bottom of the page, it has a list with the same heading that user entered while saving a new to-do item. The list shows all to-do items in short order according to due time. If there have any change at any to-do item in the organizer, the user can edit that item by clicking the "edit" icon at the end of the item name. Normally after saving a new item in the organizer the list get updated simultaneously. There has a button to refresh the list manually by clicking on "Refresh To Do" button in the top-right side of the list. When some to-do item is expired, the user will delete that item by clicking the "Delete" marked icon.

Figure 3.14: Personal organizer settings and viewer

3.9.6 Virtual Discussion Board

Usually, physical offices have a shared space or lobby at the workspace, in that place sometimes employees pass some relax moments, they gossip, sometimes discuss their work. In organizational work progress, this type of discussion and sharing of task-related material helps employees to be enthusiastic. As the proposed model will be almost similar of real world and the system has to serve such purposes. There have a module that will help user to share their contents like photo, files, personal opinion at a common area where everybody has access. In the discussion page, it will show the current discussion related post by all users. User will be

able to make comments on those posts. When any of users makes a comment the corresponding author will be notified about the comment.
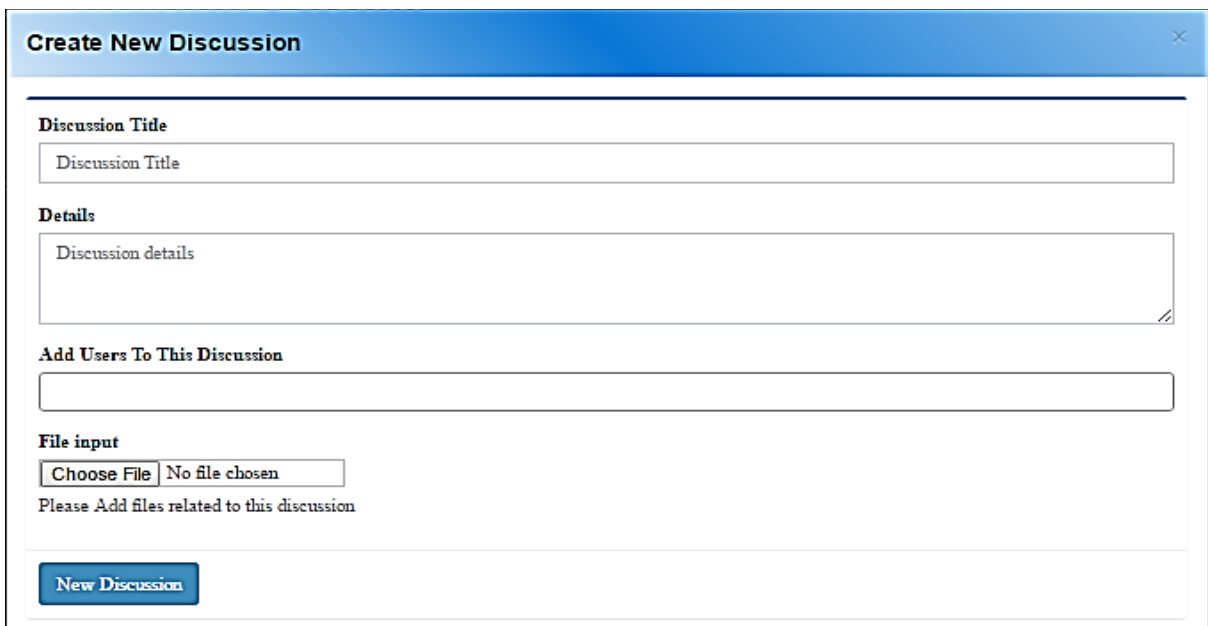
Similarly post author will reply to those comments. Using this process employee will be able to solve their discussion related task in an alternative way in virtual world. Nowadays there have a lot of social media like "Facebook," "Twitter," "Instagram" where people from far away share their feeling, their memorable moments. Likely that, using the virtual office software, people of an organization will share their organization and work-related materials among them. In the "Organizer" page, it has an area where all the task will be viewed which is shown in Figure 3.16. There has a photo icon which will contain the photograph of the user who posted the discussion topic. Bellow the photograph there has a title text area for viewing the title of the discussion topic, next to the details of the discussion. In the details, the user can write he can use the image and can attach any file. Everybody will be able to see and download the file. Sometimes the user can ask for help from his co-worker about some specific work using such a sample file. After the discussion details area, a comments section has been added to make comments on the discussion topic. After reviewing on the discussion, the user can comment over there. All such comments will be shown according to date and time as a list is attached with each discussion topics. By clicking on the new comment button, the user will open a new comment typing window. That editing panel has a lot of editing facility like formatting comment, insert the photo or other media or attaching a file. The system has an interesting option for privacy purpose, and the user will be able to specify his co-worker who will be able to see the discussion and make a comment there. There has another button named "refresh comments" which will work to refresh the comments list at a discussion and make the data retrieving process updated.

Figure 3.15: Virtual discussion page

3.9.7 Create New Discussion

The page "Create New Discussion" will be used to create a new discussion topic as well as it has been mentioned previously. To start sharing or discussing a new topic, the user has to click on "Create New" discussion button, and the page will appear. There has four data field on the page. The first one is a text type data field which is mandatory. The user has to enter the specific discussion title. The title must be subject-oriented that other can get an idea about the discussion detail. Next user will write down the details of the discussion. A strong text editor has been integrated into this module, which will provide very flexible text processing technical facility. The text processor has the option to add a photo, edit that photo into the discussion area. It has been used on this module to make the discussion posts editable so that it will be visually great and nicely elaborated to understand. The next data field is a combo list, where all usernames will be appearing. The user will select his co-workers from the list to specify

that who will be able to see his discussion topic and share their opinion by making comments. This option will add privacy for users to make their shared ideas, discussion secure from a specific person. Inside organizations, it is common that due to personal cause employee do such behaviors to share staff with the choosy person. In this module, the user can add any types of file that will be shown to others and downloadable. Sometimes it could be used to have a sample file to understand the discussion topic. For example, an employee doesn't understand an engineering drawing at an "AutoCAD" file. So he can create a new discussion topic by writing about his problem, from his co-worker list he can select the geek of "AutoCAD" and add those drawing file with his discussion. When user will just enter all necessary data and click to "New Discussion" button, the user enlisted in that discussion will get a notification. Then the corresponding co-worker will start responding on the discussion, and they can download the attached file, work on it, tell in comments what he did and also can resend the file that he worked. Using these option employees of an industry will be able to continue their gossip in the virtual world despite there not meeting physically. The entire data field in this module is mandatory, and it means the user has to enter data in all fields else the programming logic will notify the user about missing data and make sure to fill up the fields. In Figure 3.17 it is showing the new discussion creation module and its options.

Figure 3.16: New Discussion creator page

3.9.8 Internal Messaging Module

Online chat refers to a real-time text message transmission system between point to point users. Typically people use various third-party website, massager software and mobile application for chatting purpose. That could be used but functionally a chat module integrated with virtual office software to make sure that all type of communication facility accumulated in a single software package. By using a single software window, the user will be able to use all of those facilities that available differently. The existing third-party free chatting tool has some limitation like all of them do not allow sending file or image. Some has limited file size barrier. To avoid these difficulties, the system has been developed with a built-in chat module. This chat module will work as a real-time short-term communication medium. Figure 3.18 is showing the chat module of the virtual office software. In the left area, it will show the user list within an industry. The user in this list must be logged-in that they will be shown as online. Just click on the co-worker name that he wants to chat. In the right area at the user interface page, it will open the conversation panel. The user will write his message into a text box and press "Enter" from the keyboard or "Send" button on the screen to forward the message. When other users receive it, he will write his message in the same way and send that. Message from both ends will be displayed on the screen simultaneously. All of this chat data will be saved into the database until user not deleting them. To delete a specific message from the database and screen, there has a red marked "trash" icon. Just click on the icon and delete the unwarned message. To send a file to another end user, the user will click the icon in arrow-shaped, and a file selection window will open. The user will select the file and click send. Any file and any size could end from the chat module. This chat module will work as one to one communication. The system also has another group chatting facility named as meeting module.

Figure 3.17: Internal communication (message pass) chat interface

3.9.9 Employee Profile Editor

A user used to create an account in the virtual management software to get access to online. During the opening, account employee doesn't require to insert his photo. He can use his short name to open the account fast. After finishing the process when the user thinks about his profile data up-gradation, he will need such technical functionality. There has a link with user dashboard named "Update My Profile." When a user updates his profile data, he will click that link and will see the user interface shown in figure 3.19. In the interface, the first data field is the photograph of the user. Just select the photo of him that user wants to use as his profile photo, then click "Upload" button. The photo will be saved into the online database. This photo will appear to all users and organization's administrator. It will be a quick identification way of a user. The user also can change or edit his name, email address, contact, address and password from this interface. The given information will be loaded with the interface. The user will just change by typing on an editable text field. After changing the text, the user must have to click the update button to keep the change, else the new data not will be saved. There have also three data fields which are disabled in the interface. It means that user doesn't have

the permission to change the data. Actually, those fields will be manipulated by industry's management level. Administrator of this virtual office software will select those fields. The type of account and role of the user in the industry is in this data field. There has another data field named "Rank," this field also will be updated automatically according to user performance. When user will be able to finish his task within deadline a good ranking number will be assigned in this field. After each task finishing or failure, the rank field will be updated. Manager of the company and co-worker will get knowledge about user's performance by observing this rank value. As it is mentioned that the system will perform some task by itself what will reduce extra effort in management.

Figure 3.18: Employee profile editor

3.9.10 Industry/Company Profile Editor

The company profile has the primary data of an organization. Administrator of an industry will be able to change the information. To edit this data, the company's administrator will use his administrator username and password to log in as a company admin and click the button "Edit

Company Profile." In the company profile, there is the name of the organization/industry, address, contact number, email address, and business details. All of these fields are text fields, and the user can write the required data. In the top of the interface, there has an image selection module. Using this option, the company admin can use his company logo. The company logo is the identity of an industry/organization. After changing the text, the user must have to click the "Update" buttoned to keep the change, else the new data not will be saved.

Figure 3.19: Company profile editor

3.9.11 Virtual Meeting Management Module

A study says that arranging a meeting at an organization requires time, a shared space for meeting, utility and operational cost. So if it is possible to eliminate the traditional meeting procedure, it can save time and make the operation management cost effective. A meeting module has been developed which is integrated with the virtual industry model. The model named "Meeting Zone." Inside the virtual office software, the user will find an interface shown in figure 3.21. If any employee wants to call a meeting, he will click on the button "Call a Meeting." The module also shows the upcoming meeting list. In the list, the user will

see the topic of the meeting, who called the meeting? Agendas of the meeting, schedule and finally a counter to showing the upcoming meeting's remaining time. In the last column, it has a link with a symbol marked as a "circle," a user will click on this circle to join the meeting. However, only can join when the meeting time matches with the current system time. Below of upcoming meeting list user can find the previous meeting's data. Last five meeting's data will be shown here, what was the topic of the last meeting, the name of the responsible person that called the meeting, agenda, and regulation.

Figure 3.20: Virtual meeting notification page

3.9.12 Call new Meeting Module:

This module will be used to create a new meeting data and throw that to all. The employee who has enough supremacy to call a meeting he can use the option. To arrange a meeting, it is imperative to find an available date. When the user selects a date into the input box, the program will check that any other meeting called at that date or not, if it finds the date free, then it searches for available time, because two meeting could be arranged at the same date in different time. After finishing the date and time selection process user has to enter a meeting title, the title should clarify the meeting details in a sentence. For example, an organization demands to develop a new product or creating a new market so that the manager will discuss

with others, in this case, he can write "Meeting about new product design for local market" which says that the meeting is about developing and launching a new product. The next input field is a text box where the agenda or specific discussion topics will be given. Multiple sentences could be written here. The user can list the agenda according to priority. For example, the agendas could be like "1. Analysis and discussion on the local market, 2. Market demands analysis. 3. New product designs and cost. 4. Marketing process." If user input like this, his co-worker and respective employees will be able to prepare the necessary materials for the meeting. These fields are minatory, and the system will always ask to input the meeting title and agenda, there was no chance to create meeting documents with a flaw. Finally, assign a user for the meeting. It means to notify the co-worker who has to attend the meeting. In an organization different meeting conducts with a different group of employee. The user is assigning option customizable that the caller of a meeting can add only the people who are specified for the meeting and only they will receive the notification and counting notice about the meeting. When all the required data fields will be fill-up then user has to click on the button "New Meeting" at the bottom of the interface window shown in figure 3.22 the meeting will be saved, respective employee will receive a notification email, and system will show a down counter timer which indicates the remaining time of meeting.

Figure 3.21: New meeting caller page

3.9.13 Live Meeting Module

The system has a significant option as it can arrange a meeting at online using the virtual office software. The module will work as a common online chat room in the virtual world. As it is mentioned before that, responsible member of management could call a meeting. Everybody will be informed of the meeting time schedule, and the system will start counting time when the current time will match with the predefined time for the meeting, employees of the company will get access to join the meeting. The user can share his opinion by text message to other in the meeting room, but in the further development process of this software, users can add a voice transmission option. Everybody can send a message simultaneously, and everyone will be able to see other's discussion on the meeting agenda. The entire discussion text message that wrote by different employees will be recorded, and finally, responsible management authority will make the decision on the meeting and show that to all if everybody seems to agree with the decision, then it will be signed as a regulation. The system will generate an automatic regulation. The regulation will be stored in online memory for documentation and printing purpose. In a typical management system, all of this process requires a long time and manual documentation, rather the online virtual industry model can perform the task using the limited resource and smarter way.

Figure 3.22: Live virtual meeting page

3.9.14 Create Meeting Resolution

Typical resolutions have several parts the timetable and venue information, attendees' information, a brief description of the meeting, taken decisions, signature of attendees. The virtual office system can generate a resolution automatically from the online meeting data, all of the required data would be collected, and it will be formatted as a handmade physical resolution to print.

3.9.15 Company Administration Area

To control user/employee's activities, the administrative staff of industry will use this module. When he logs in into account, he will see the list of the total employee using the virtual office tools to stay connected virtually. In the list, the name of the employee, his status that online or offline, his account status will be shown. If the administrator wants to see the complete profile of an employee, click on his name and his details data will be shown to the administrator. The online status will show online when the user is using the virtual office system else it will show "offline." The next column "account status" means the status of an employee that he is approved by the company to use the system. In front of every username list, there has a switchable toggle button which has two states. If the user has approval, the button will show as "On" else "Off." To disable any employee's account, the administrator will set the button as "Off" or approve any new account or disabled account, set the button as "On." If an organization feels that he needs to stop the activity of an employee, they can use this option. As the system is online software which is open to the world. Any user or hacker can create a fake account using any company name, but he not will be able to do anything until the company administrator as making sure that he is a valid employee of corresponding origination. There has a search field in the top of the list. When the employee list is large, management has spent more time to find a specific employee from the list. So using this search text field, the administrator will type specific employee name list and the system will find the usernames which data matched with an entered search string. If the admin wants to get the employee name in specific file format to use different purpose, he can download the list of

"CSV," "Excel," or "PDF" format. There have a printing option to print the employee data as hard copy.

Figure 3.23: Company Administration page

3.9.16 Super Admin Dashboard/Software admin panel

In the virtual industry model software, the super admin is a built-in user. During the installation of software, it will be the only user to manage the system and approve other organization to register on the system. Super admin usually can see some necessary information about the organization only, and he will be unable to access other information and database of an organization. This is an issue of safety and privacy of an industry. Security is the big challenge to the online software-based system. To ensure highly secured information processing and online communication in the administration part of the web software has been developed with very limited data retrieval permission. Super admin will get a new organization registration request and verify the data given by the applicant. He can make a call or find information about the company validity. If the company has real existence, the super admin will select the "Active" option beside the company name list, simultaneously the organization's account will be active to start their operation in the virtual world. In the meantime, an email notification will be sent automatically to the applicant that his account is ready to use. If the super admin finds that someone trying to register a fake

company/organization/industry he will select the inactive option and the account will never be activated. It might be containing millions of company and employee information, their activities related records but super admin only can see the company name, contact address, logo, details of their business, email address. How many of the employees are using the virtual office software, what type of communication they are doing? It will never be displayed to the super admin. Sometimes people think that the administrator can read all the data which could make the information security vulnerable to an organization. As the system has been developed using data encryption technique, so if the super admin or the software engineers who will maintain the system access the database, he will see some garbage value! Those are only visible to the organization. There has some functionality in the super admin dashboard that, when the virtual office software will be used by hundred or thousand or organization then admin can search any company using "Search" string. For documentation of hard copy data, it has options that convert all available company information on .pdf, .xls or CSV file. After conversation super admin can download the data and using the print command, he can print the data and keep a printed copy of any emergency or critical data fault. As another super admin user, the virtual office software's super admin doesn't have enough power of user and information control for freedom and security of the virtual industry model. The proposed system has been developed to avoid the existing similar expensive technology and their bindings. So this model software not will be a money making software, it will be a free platform to transform and extended industry into the virtual world.

Figure 3.24: Super admin/software administrator page

3.9.17 Documentation and Job status tracking

In virtual model software, it has a nice option that it keeps the data automatically which generally stored manually. For traditional management, usually, people keep the printed copy of all type of document and make a compilation. The virtual model has a good option that it can track and show the company supervisor a summary of the total job. Figure 3.27 is showing the administrator dashboard of the virtual model software, where it has 4 counters that show the number of total employees, the total pending task, how many tasks are being a process and the total finished task/job of the company/firm/industry. It is a little bit difficult to monitor and track the job status manually inside an organization. Sometimes some job could be out of mind in a manual system, where the virtual model always shows the job status when the company supervisor opens his dashboard. It happens within second because the system already saved all those data and it has a robust logical programming module to do that work. Comparatively the traditional manual system has some system like write down the task in a whiteboard, keep note and personal reminder. This takes more time than and not as smart as the virtual model. Virtual office software also keeps the total job list according to some parameter like finishing date, assigning body, job status. So in the case of documentation, the virtual model has better option and performance than the traditional method. In the administrator's dashboard, there has a graph that shows how many tasks completed and in the uncompleted state in the running month. This is a visual presentation of job statistics which will help to monitor and control the management hierarchy. A pie chart has been added which gives a clear view of a second. The chart has three different colors, where the green color indicates the finished job, the light green color indicates the under processing job and the red colored portion indicates the pending job. If the user puts the mouse pointer towards the color, it will show the number of tasks. It was mentioned before that the cause for developing a virtual working model based on software could be an excellent solution which will be all in one. The user assigns a task using it, and the user can track the task and no need for extra documentation work. In case of to need it can export the total job list to desired file format and print it for hard copy documentation.
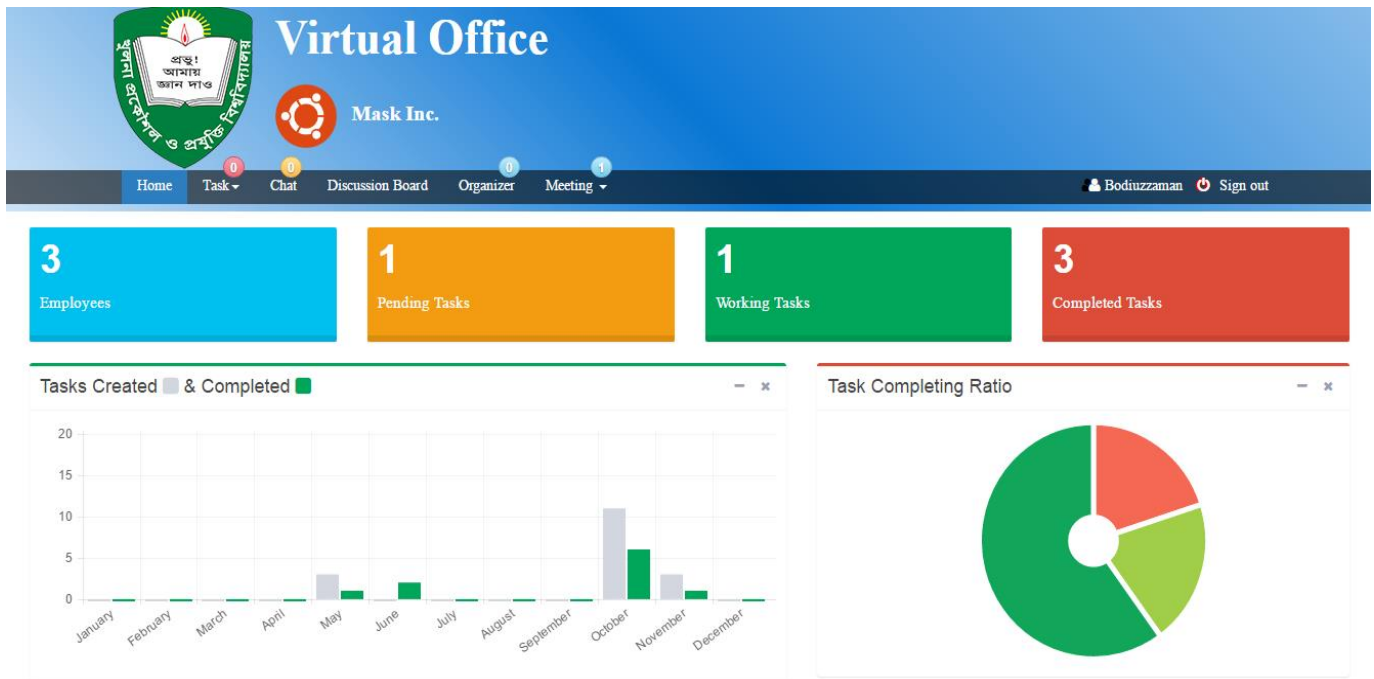
Figure 3.25: Task/Job statistics visualized report

3.9.18 Employee performance evaluation

There have lots of paid-software to manage human resource and evaluate their performances. Usually, that software is also an online web portal which offers companies to track, monitor and evaluate the human resource. In the virtual model it has a nice option that can calculate how many tasks was finished at right time by the employee. The system automatically starts calculating that when the corresponding employee finished his task, if it done within the timeline it gives him 5 stars out of 5 if it became late the stars start decreasing. In this way the system will calculate all activities according to due time and make a top list with top ten performers. Despite the software can't generate 100% employee evaluation data right now but it can give an overview of an employee and his task finishing rate according to time.

Figure 3.26: Employee Evaluation by task finish rank

CHAPTER IV

Performance Test and Results

4.1 Application of "Virtual Industry Model" on a private limited company

To evaluate the performance and test the function ability, the developed software has been applied to two private limited company which has a strong background to use the virtual model. The company information and procedure of application described below

Company 1

Organization/Company Name: E-Life Private Limited.

Address: Kisukkhon 44/12, Mujgunni South Para, Khulna.

Business Description: E-Life limited is an electrical and electronics goods manufacturer and importer company. It usually works on research and development of new electronics and electrical devices like "power supply, UPS, IPS, Voltage Stabilizer, LED Lamp, Solar Charge controller, etc. Sometimes the company import goods from the foreign manufacturer as demand as like CCTV security and networking devices. The company has a third party marketing agency that does the marketing and end level customer dealings.

Company 2

Organization/Company Name: Mangrove Apparels

Address: Boira, Khulna

Business Description: The name of the factory is "Mangrove Apparels" where 110 workers are engaged in several sections. The factory produces sportswear, t-shirt, trousers and customized ready garments according to the client's order. There have a cutting section, a sewing floor, ironing and finishing section, and a print section. All the processing units are situated at the 5th and 6th floor of a nine-storied building. There is a difficulty in the factory

about communicating with design section. The designer and design section situated on the ground floor. Usually, the head of the print section communicates physically with the designer to collect the design regarding various products. Print section gets the soft copy of design which will be printed on the product by a flash drive. It was found that it is a time-consuming process to visit the ground floor and collect the design then come back to the 6th floor. They tried the email system but email has file size limitation, and they exchanged design with another email. In this case, the head of print section and designer registered with "virtual office software" and started using the system to communicate virtually. They were able to communicate faster and data exchange within a moment. A time study on the following job was conducted, and the result has been discussed later.

4.2 Performance Test

The performances test of the developed virtual management software has been done by time study. The procedure of time study are discussed below.

4.2.1 Time Study Tools

For the time study test the following tools is used.

1. A stop watch
2. Time study format
3. One pen or pencil
4. Time Study board

4.2.2 Procedure of Time Study

The organization has the different type of working sector and employees, working for management, research, and development, product design, production control, quality control, marketing. The virtual office model has been applied for the organization to perform their task from remotely in the cyber workspace. The company authority was asked to create an account for some of their employees from management, engineer, worker, and marketing segment. After creating their user profile and company profile the started to use the virtual office software to communicate and operation management in the virtual world. Individually the

managing director of the company, the product designer, R&D engineer, production supervisor, and marketing executive to create an account at virtual office software and start using the virtual industry model. In the organization, the managing director decides to launch a new product and tells that to the product designer. Product designer designed the desired product after getting the directions and necessary documents from online communication. To approve the design, managing director will be able to call a virtual meeting in online to discuss with a co-worker. During the meeting time, employees from the different geographic location will meet at virtual work-space, they can share their opinion talk over the product design that is the design correct or needs sub deletion/addition? When an employee can make the final decision about the design of a new product, the managing director approves the design. Simultaneously product designer makes the proper documentation about the design and forwards the design file of the new product named "Emergency Power Supply" to the production department. Product designer attached the circuit diagram, the schematic diagram, PCB layout and part details related necessary files. Also, he set the deadline to finish the production. When the production supervisor started demo production and testing the sample he found that the given circuit design has some bug, especially it is a microcontroller based programmed circuit. In this circumstance, the production designer creates a discussion by adding the R&D engineer and product designer. In that time both of the product designer and R&D engineer got an email notification that there has a design fault of the ongoing product's design. Immediately product designer submits his opinion by commenting on the discussion that "We should get some help from R&D engineer." In that time R&D engineer is very busy with some different business, but he got that due to this error the production of a new product postponed. He set "To-Do" tasks into his organizer list of next day as priority. In the next day, the virtual office software sends an email notification to R&D engineer's dashboard, as he is using a smartphone he got that notification as an alarm. R&D engineer opens his laptop/computer, log in to his account and read the details of the error in product design. He downloaded the simulation files, the related program and commented that on a short time he would be able to solve the bug. R&D engineer starts working with the product design and other details at his residence. The total process was going through online using the virtual

industry model. The observation on the task they did using virtual office model and a comparative scenario given Table 4.1.

Table 4.1: Comparative time and coast analysis of different job between virtual model and traditional system.

Task Information		Processing using Virtual Office Model			Processing without using Virtual Office Model		
Sl.	Task Detail	Procedure of Processing	Taken Time	Cost	Procedure of Processing	Taken Time	Cost
1	Decision Making: Meeting about launching a new product.	Use virtual Meeting Module, set meeting time, employee got notification, login into system in that time, attend from any geographic location.	Arranged within a few hour	0	Notice to employee, ask them to gather the conference room, meet physically in common place	Minimum a day	Felicitation & Utility costas
2	Product Design: Asking the product design department to design a new power backup device "Emergency Power Supply"	Assign a new task using the task management tools of virtual office software, respective employee receive the task from his local location.	Few minutes to assign the task+ (Task finishing time)	NA `	Gather necessary files, load the soft copy into flash drive, send to the co-worker using human carrier	Minimum 30 minutes to assign the task+(Task finishing time)	Printing Cost/Extra staff salary
3	Product Design: Demo production	Send the simulation file to the	Few minutes to	NA	Gather necessary files, load	Minimum 30 minutes to assign the	Printing Cost

		production department using task creation tools	assign the task+ (Task finishing time		the soft copy into flash drive, send to the co-worker using human carrier	task+(Task finishing time)	
4	Demo Product Testing: Fault in demo product due to design flaw, need to discuss over the matter with respective employee	Use the discussion tools of virtual office, invite respective employee, discuss over online communication (Chat, file sharing, voice communication)	Approxi--mate 2 minutes to inform everyone	0	Physically go to the respective supervisor office, show the error, have to meet physically at office	Minimum 30 minutes to arrange	Optional utility cost
5	Business Communication: Contact with Marketing Executive to get market analysis and forecasting	Use group task assigning to send the job order to marketing associate employees, respective employee will get a notification with necessary direction. After getting that employee will prepare the report and	5 minutes to assign group task + Task finishing time+ 5 minutes to forward the task	NA	Organize a business meeting, meet at office	Half of a day + Task Finishing	Utility cost+ Communication Cost

		forward that to supervisor.				
6	HR Evaluation: Make a performance report of employees to evaluate their efficiency	As the task finishing data will be recorded, so go to industry's admin account ant get the data of employees that how often they failed their timeline or the rate of task finishing in due time.	Within a single click	Only printing Cost of hard copy	Collect the SCR report, manually analyze the employee's work history, type and evaluate them manually.	Few Days	Cost of data collection and printing

4.3 Results of Time Study

Time Study using Developed Software

Job name: Contact with manager to purchase a software license for outsourcing team.

An operation cycle in traditional way of asking the manager to purchase software license code a team member usually physically meets the manager, tell him the requirements and request to purchase a license for a software. In this case, it performed the operation using virtual model. The operation cycle has some task which is, login into virtual office software, open the task creation page, type the task details and submit the task, manager receive the task, purchase the license from internet, type the license in his work, set the task status completed and submit to corresponding member. The individual small task to finish this operation could be like as follows

i) Login into virtual model software and open task creator page

ii) Write down the details of task and submit to manager

iii) Manager gets notification and understands the task

iv) Purchase the license and type key into task

v) Set the task status completed and submit to corresponding member

Table 4.2: Time study observation sheet of the operation "*Contact with manager to purchase a software license for outsourcing team*" for company 1 (Using developed management software).

Time study observation sheet						
Department:	*Product Development*	**Section:**	*Outsourcing*	**summary**		
Section head:	*Nasim*			A	study ends:	10.35 am
Analyst	*Badiuzzaman*	**Date:**	*10 November*			
Operation:	*Contact with manager to purchase a software license for outsourcing team*			B	study starts:	10.03 am
				C	study time:	32 min.
				D	check times:	1.68 min.
				E	total study time:	33.68 min.
				F	elapsed time:	34 min.
				G	difference F-E	0.32 min.
				H	timing error: G/F%	0.9%
Element number	**Element Description**	**rating**		**observed time (cm)**	**basic time (cm)**	
1	Login into virtual model software and open task creator page	90		41	36.9	
2	Write down the details of task and submit to manager	80		53	42.4	

3	Manager gets notification and understands the task	80	58	46.4
4	Purchase the license and type key into task	90	250	225
5	Set the task status completed and submit to corresponding member.	75	60	45

Table 4.3: Time study analysis sheet of the operation "*Contact with manager to purchase a software license for outsourcing team"* for Company 1 (Using developed management software).

Time study analysis sheet						
Department:	*Product Development*				**Section:**	*Outsourcing*
Section head:	*Nasim*				**Date:**	*10 November*
Operation:	*Contact with manager to purchase a software license for outsourcing team*				**Analyst**	*Badiuzzaman*
El.	**Element Description**	**basic times (b.min)**			**RA%**	**std.mins.**
		basic t.	**frequency**	**b.t. x freq.**		**(sm)**
1	Login into virtual model software and open task creator page	36.9	1/1	0.369	10	0.406
2	Write down the details of task and submit to manager	42.4	1/1	0.424	10	0.466
3	Manager gets notification and understands the task	46.4	1/1	0.464	10	0.510
4	Purchase the license and type key into task	225	1/1	2.250	10	2.475
5	Set the task status completed and submit to corresponding member.	45	1/1	0.450	10	0.495

					total sm =	**4.352**

Time study without using software

When the same operation was performed in traditional system the operation was classified in the following small steps

i) The team member had to go first floor to tell the manager.

ii) He discussed with Manager and told him about they need.

iii) Manager understood the needs clearly and asked the member to come when he will call.

iv) Purchased the license and call the corresponding member to take the key.

v) The team member went to manager room again form ground floor, collected the key and came to workplace at ground floor.

Table 4.4: Time study observation sheet of the operation "*Contact with manager to purchase a software license for outsourcing team*" for Company 1 (Without using software).

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Time study observation sheet						
Department:	*Product Development*	**Section:**	*Outsourcing*	summary		
Section head:	*Nasim*			A	study ends:	10.35 am
Analyst	*Badiuzzaman*	**Date:**	*10 November*			
Operation:	*Contact with manager to purchase a software license for outsourcing team*			B	study starts:	10.03 am
				C	study time:	32 min.
				D	check times:	1.68 min.
				E	total study time:	33.68 min.

		F	elapsed time:	34 min.
		G	difference F-E	0.32 min.
		H	timing error: G/F%	0.9%

Element number	Element Description	rating	observed time (cm)	basic time (cm)
1	The team member had to go first floor to tell the manager.	90	220	198
2	Team member discussed with Manager and told him about they need.	80	300	240
3	Manager understood the needs clearly and asked the member to come when he will call.	80	45	36
4	Purchased the license and call the corresponding member to take the key.	90	250	225
5	The team member went to manager room again form ground floor, collected the key and came to workplace at ground floor.	75	240	180

Table 4.5: Time study analysis sheet of the operation "*Contact with manager to purchase a software license for outsourcing team*" for Company 1 (Without using software).

Time study analysis sheet			
Department:	*Product Development*	**Section:**	*Outsourcing*
Section head:	*Nasim*	**Date:**	*10 November*
Operation:	*Contact with manager to purchase a software license for outsourcing team*	**Analyst**	*Badiuzzaman*

El.	Element Description	basic times (b.min)			RA%	std.mins.
		basic t.	frequency	b.t. x freq.		(sm)
1	The team member had to go first floor to tell the manager.	198	1/1	1.98	10	2.178
2	He discussed with Manager and told him about they need.	240	1/1	2.40	10	2.640
3	Manager understood the needs clearly and asked the member to come when he will call.	36	1/1	0.36	10	0.396
4	Purchased the license and call the corresponding member to take the key.	225	1/1	2.25	10	2.475
5	The team member went to manager room again form ground floor, collected the key and came to workplace at ground floor.	180	1/1	1.80	10	1.980
					total sm =	**9.669**

Company 2

Job name: Head of print section has to collect a design from design section and start printing process.

Using virtual system the job could be slotted into following elements:

i) Call the designer to send the design.

ii) Designer login to the system and open chat module.

iii) Send a message to head of print section including the design file as attachment.

iv) Head of print section receive the file and send acknowledgement.

v) Download the design file and start processing.

Table 4.6: Time study observation sheet of the operation "*Head of print section has to collect a design from design section and start printing process.*" for company 2 (Using developed management software).

Time study observation sheet						
Department:	*Printing*	**Section:**	*Design*		summary	
Section head:	*Mubin*			A	study ends:	11.40 am
Analyst	*Badiuzzaman*	**Date:**	*06 November'18*	B	study starts:	11.00 am
Operation:	*Head of print section collects a design from design section and start printing process*			C	study time:	40 min.
				D	check times:	1.68 min.
				E	total study time:	41.68 min.
				F	elapsed time:	42 min.
				G	difference F-E	.32 min.
				H	timing error: G/F%	0.7%

Element number	Element Description	rating	observed time (cm)	basic time (cm)
1	Call the designer to send the design.	95	50	47.5
2	Designer login to the system and open chat module.	85	45	38.25
3	Send a message to head of print section including the design file as attachment.	85	75	63.75
4	Head of print section receive the file and send acknowledgement.	80	85	68

5	Download the design file and start processing.	90	70	63

Table 4.7: Time study analysis sheet of the operation "*Head of print section has to collect a design from design section and start printing process*" for Company 2 (Using developed management software).

Time study analysis sheet						
Department:	*Print*				**Section:**	*Design*
Section head:	*Mubin*				**Date:**	*6 November18*
Operation:	*Head of print section collects a design from design section and start printing process*				**Analyst**	*Badiuzzaman*
		basic times (b.min)			**RA%**	**std.mins.**
El.	**Element Description**	**basic t.**	**frequency**	**b.t. x freq.**		**(sm)**
1	Call the designer to send the design.	47.5	1/1	0.475	10	0.523
2	Designer login to the system and open chat module.	38.25	1/1	0.382	10	0.420
3	Send a message to head of print section including the design file as attachment.	63.75	1/1	0.637	10	0.701
4	Head of print section receive the file and send acknowledgement.	68	1/1	0.680	10	0.748
5	Download the design file and start processing.	63	1/1	0.630	10	0.693
					total sm =	**3.085**

Time study for the same job in existing method

When the same operation was performed in traditional system the operation was classified in the following small steps

i) Call the designer to know the design is ready or not.

ii) Come down from 6th floor to ground floor's design section.

iii) Handover a flash drive to collect the design.

iv) Go back to 6th floor with the design in flash drive or similar device.

v) Copy the design to print section PC for processing.

Table 4.8: Time study observation sheet of the operation "*Head of print section has to collect a design from design section and start printing process*" for Company 2 (Without using software).

Time study observation sheet						
Department:	*Printing*	**Section:**	*Design*	**summary**		
Section head:	*Mubin*			A	study ends:	09.35 am
Analyst	*Badiuzzaman*	**Date:**	*06 November18*	B	study starts:	09.00 am
Operation:	*Head of print section collects a design from design section and start printing process*			C	study time:	33min.
				D	check times:	1.5 min.
				E	total study time:	34.5 min.
				F	elapsed time:	35 min.
				G	difference F-E	0.5 min.
				H	timing error: G/F%	1.4%

Element number	Element Description	rating	observed time (cm)	basic time (cm)
1	Call the designer to know the design is	95	50	47.5

	ready or not				
2	Come down from 6th floor to ground floor's design section	95	250	237.5	
3	Handover a flash drive to collect the design.	90	95	85.5	
4	Go back to 6th floor with the design in flash drive or similar device.	70	550	385	
5	Copy the design to print section PC for processing.	80	80	64	

Table 4.9: Time study analysis sheet of the operation "*Head of print section has to collect a design from design section and start printing process*" for Company 2 (Without using software).

<table>
<tr><td colspan="7" align="center">Time study analysis sheet</td></tr>
<tr><td colspan="2">Department:</td><td colspan="3"><i>Product Development</i></td><td>Section:</td><td><i>Outsourcing</i></td></tr>
<tr><td colspan="2">Section head:</td><td colspan="3"><i>Nasim</i></td><td>Date:</td><td><i>10 November</i></td></tr>
<tr><td colspan="2">Operation:</td><td colspan="3"><i>Head of print section collects a design from design section and start printing process</i></td><td>Analyst</td><td><i>Badiuzzaman</i></td></tr>
<tr><td rowspan="2">El.</td><td rowspan="2">Element Description</td><td colspan="3">basic times (b.min)</td><td>RA%</td><td>std.mins.</td></tr>
<tr><td>basic t.</td><td>frequency</td><td>b.t. x freq.</td><td></td><td>(sm)</td></tr>
<tr><td>1</td><td>Call the designer to know the design is ready or not</td><td>47.5</td><td>1/1</td><td>.475</td><td>10</td><td>.523</td></tr>
<tr><td>2</td><td>Come down from 6th floor to ground floor's design section</td><td>237.5</td><td>1/1</td><td>2.37</td><td>10</td><td>2.607</td></tr>
<tr><td>3</td><td>Handover a flash drive to collect the design.</td><td>85.5</td><td>1/1</td><td>0.855</td><td>10</td><td>0.941</td></tr>
</table>

4	Go back to 6th floor with the design in flash drive or similar device.	385	1/1	3.85	10	4.235
5	Copy the design to print section PC for processing.	64	1/1	.640	10	.704
					total sm =	**9.01**

4.4 Result Summary and Discussion

In this study, two different type of company has been chosen and the time study results shown in figure 4.1. From this results it can be seen that by using this software company can save a significant amount of time for a specific task.   Therefore, less time to finish an operational cycle will increase the productivity and decrease the operational cost. Which effects on production cost per unit. Similarly it is possible to finish many other jobs in lower lead time by apply the virtual model software.
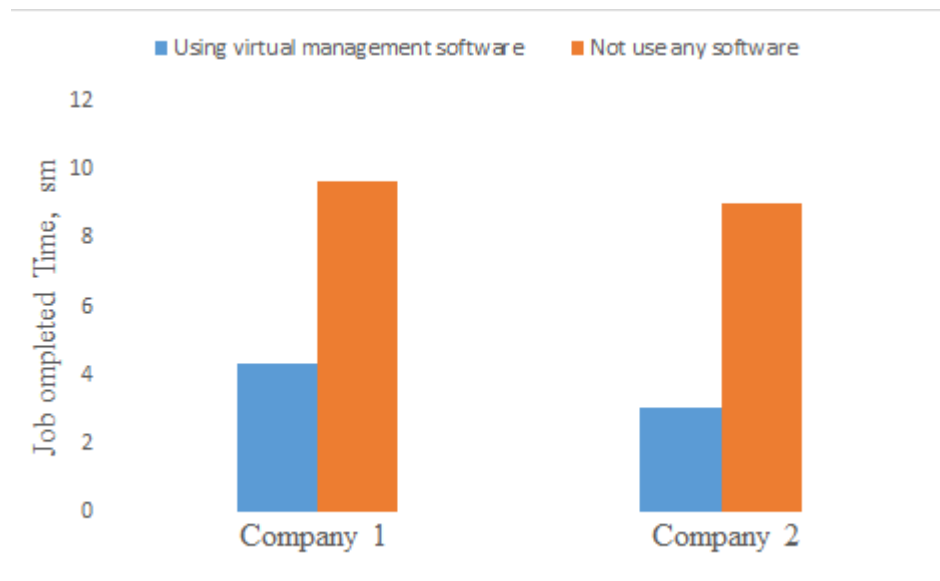

Fig. 4.1. Time study results of Company 1 and Company 2

A whole new approach is needed for managing employees in a virtual environment, in order to leverage the benefits associated with remote computing without having them erased by the potential negative aspects. It was found through this study that virtualization of management is the future. Gradually the paradigm of virtualization is boosting. In the upcoming industrial area cyber based management and virtualization will lead the management process. We found that the current virtualized system and virtual organization works based on a software service which is expensive in term of cost. To make the virtualized management adaptable for all range of organization it is necessary to have a cost effective or free platform. Also that platform should be integrated software that will contain all the features which is must require to run a virtual organization. In this study we found that a product base virtual company could be found rather than a service based virtual organization. As the proposed product based virtual company will use a shared physical infrastructure regarding production and other purposes then the overall investment for a production system will be reduced and cost effective than the traditional way. In this work we revealed a new software service based virtual company formation and also applied the software on an existing company. Using communicator software, elements of an organization could be accumulated from any geographic location and perform their task from there. It was found that the software based virtual organization can communicate faster which can increase productivity and various limitations. Despite this kind of organization might be the cause of reduce employment facility and lag of social interaction but this is the trend due the fast growing upcoming industrial revolution. We must have to synchronize with the current changes in industrial revolution and virtualization of management of a complete virtual industry/company/ organization is a reality that has been discussed, developed and deployed in this work. We hope that this work will help people to get idea and apply virtual management in their organization

CHAPTER   V

Conclusion and Further Development Possibility

5.1 Conclusion

In this study, proposed a framework named "Virtual industry model" and with the concept of virtual office management software have been developed and verified by practical application. This virtual management system is a new way of working that enables the virtual worker to works outside the walls of the traditional office. A system has been developed that will be the structure of all working process of an industry through internet and others ICT tools in where the total system is operated using online software that can communicate, synchronize among all segment of the production process. Thus, entrepreneurs can fulfill their dream by establishing an industry at a little cost, and less paper works as well as they can make their product more versatile compared to the other traditional industry. To evaluate the performance and test the function ability the all-new developed software has been applied to a private limited company. From time study analysis it was observed that the virtual industry model can save almost 5 minutes time for a common task which could be repeat several times in a day. From decision making, product design, production planning, production control to marketing, the industry used the virtual office model on several stages, and they were able to save their, time, their money and found the operation management easier.

5.2 Limitation of "Virtual office Model"

To fulfill the requirements of industry and established the model, the following factors should be considered

   i) The system runs over the internet so the organization must have good internet connectivity.

   ii) All type of documents and work-related data should be converted into the soft version.

   iii) As the job order and other communication will be done by the software, so the user has always followed the software's notification and follow them.

iv) Lazy people can lose their job because here the system doesn't have any physical monitoring.

v) To use the model the company has to install necessary ICT equipment like computer, printer, and network to work using the model. This can make people less interested in starting using the virtual model.

vi) Lack of nonverbal communication.

vii) It will cause a lack of social interaction.

viii) Team spirit could be less than face to face communication.

ix) Only sincere people are suitable for this model.

x) It is must check the software notification and always keep eyes on the screen.

5.3 Further Development Possibility

There also has some future development option which can make the proposed virtual model software more useful for industries and more user-friendly. Further scope of development of this virtual model are as follows.

i) Develop Android and other mobile platform application to bring the system into palm.

ii) Integrate the system with ERP software.

iii) Integrate e-commerce site for direct product selling on the internet.

iv) Develop a virtual reality application for Google glass or another virtual reality device.

v) Develop a virtual office system with artificial intelligence and machine learning.

vi) Develop an IoT based industry.

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