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Development a File Transfer Application by Handover for 3D Video Communication System in Synchronized AR Space

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ABSTRACT

Existing video communication systems, used in business or private life, provides file data transfer function. However, these systems need many manipulation steps by using mouse and keyboard. These steps are not easy to transfer files for the PC beginners. Furthermore, it is not intuitive action from the point of view of handing of things. In order to solve these issues, we have proposed 3D video communication system by using Kinect and Head Mounted Display (HMD). This system provides users communications with realistic sensation and intuitive manipulation. In this system, users can see the other user's body part through HMD and communicate in AR (Augmented Reality) space. In this paper, we provide a intuitive file data transfer application by handing of AR objects using this system.

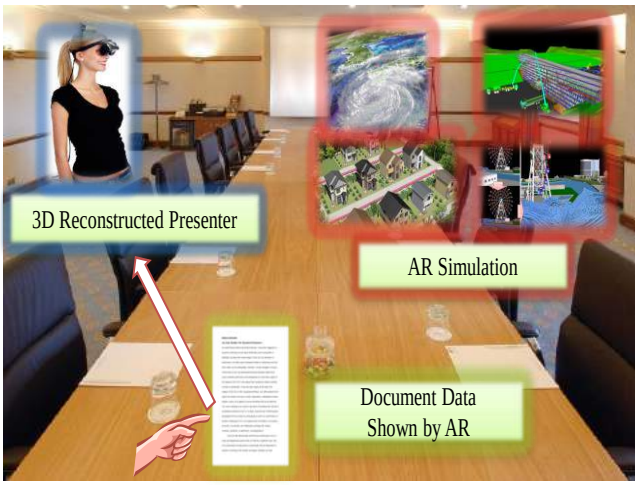
KEYWORDS

3D, Communication system, Intuitive, Data transfer application, Kinect, Head Mounted Display

1 INTRODUCTION

In recent years, by the development of network technology and the spread of PCs, smart phones and tablets, communication systems using a network have become an indispensable part in our lives. For example, there are E-mail, SNS, and the Internet call service. These systems have transmitted information through 2D intermediaries such as characters, images, voice, and video. Moreover, with the development of video technology, recently we have seen many techniques using 3D information. If we combine these technologies and show the body of the other user and objects in 3-dimensional space, we consider that the communication can be smoother and realistic. There are various systems as existing 3D video communication systems. For example, there are the hologram system using the 10 Kinects [1], the 3D reconstruction system by using the marker [2] and the system which reflects the movement of the user in an avatar [3]. However, they can't share the same space, and realistic sensation is insufficient. In addition, although existing video communication systems provide the file data transfer function such sending and receiving file data as a word, pdf, or mp3 file, it does not have intuitive manipulation, and needs many manipulation steps of clicking of mouse.

To solve these issues, we have developed a 3D video communication system using Kinect and HMD (Head Mounted Display) [4]. In this system, users at remote locations are reconstructed each other in the AR space [5]. Furthermore, they can share superimposed virtual objects and move it intuitively. As expected merits of this proposed 3D video communication system in the future, for example, 3D video business meeting in AR space. Users can share documents, slides, viewing surfaces and virtual objects. Moreover, they can transfer file data by hand operation. Furthermore, they can share AR buildings, and execute simulations of wind and sunshine. we expect that business meeting will be more smooth by means of these functions. Figure 1 is the image picture of expected merits.



In order to implement the above system, firstly we propose an intuitive data transfer application by the handover.

2 PROPOSED SYSTEM

Figure 2 shows the configuration of this system. Figure 3 shows the flow of processing in this system. Explanations of each process are following below. This system uses Kinect and HMD.

Step 1: Obtaining RGB and depth data.
2 PCs obtain RGB and depth data from Kinect at the beginning of system flow.

Step 2: Extracting the human body.
After obtaining RGB and depth data, each PC extracts each human body by basic function of Kinect. Kinect can detect skeletal data of a human body composed by 20 joint positions. We use this basic function to extract the human body. When Kinect detects skeletal data of a human body, this system keeps depth data of the human body, and deletes other pixels depth data.

Step 3: Detecting the users face direction.
By using the function of HMD, this system detects face directions of the users. This process

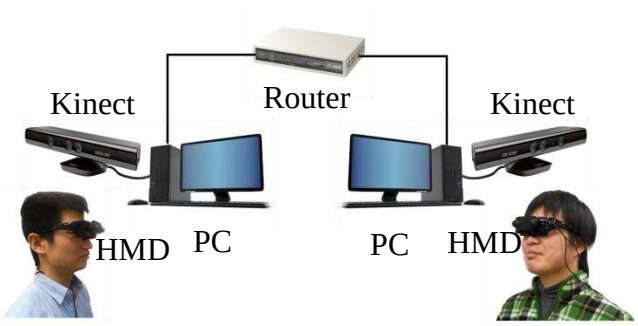


Figure 2. The configuration of this system.

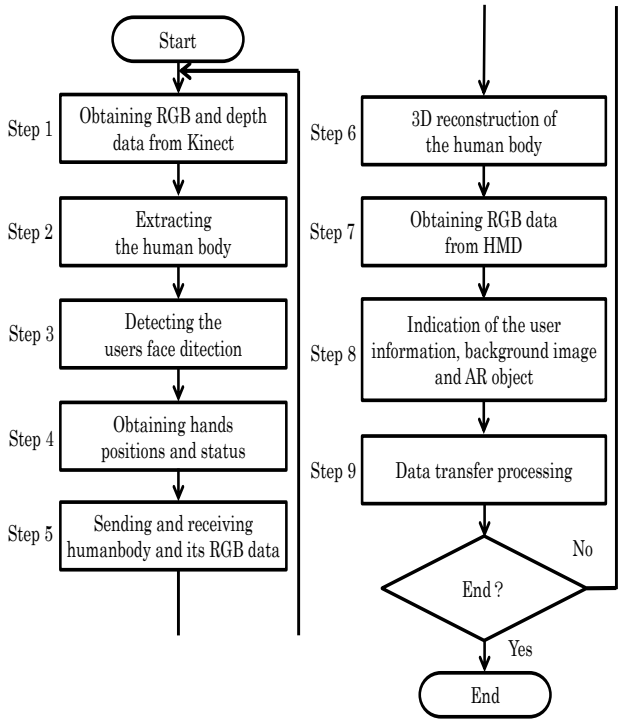


Figure 3. The flow chart of this system.

uses a gyro sensor of HMD. Therefore, this system is able to detect users face direction.

Step 4: Obtaining hands positions and status.
Kinect obtains hands positions and hands status which are grip or no grip. This function is provided by Kinect SDK.

Step 5: Sending and receiving the human body data and its RGB data.
Each PC sends and receives the human body data and its RGB data through socket programs [6]. The human body data includes depth data, rows and columns of pixels of depth data.

Step 6: 3D Reconstruction of the human body.
After this system received human body data, it reconstructs the extracted human body to 3D model through OpenGL [7]. When this system reconstructs the human body, it adds RGB data on each depth pixel. Therefore, users can see human body of 3D with colors.

Step 7: Obtaining RGB data from HMD.
HMD obtains RGB data by 2 cameras of HMD.

Step 8: Indication of the user information, RGB image of HMD and AR object.
HMD shows RGB image of HMD cameras behind the reconstructed human body, and displays an AR object within the sight of HMD. A user can see another user as if he/she was in the same room through this process.

Step 9: Data transfer processing.
Both PCs judge the contact between the AR object and the user's hand.If both user's hand contact with the AR object, both PCs send and receive data.

Figure 4 (a) and (b) show the initial state of the experiments. User A and B are in the different room, and stand in front of Kinect. Both of them look at each other through 3D reconstruction within the sight of HMD. In the Figure 5 (a) and (b), user A moves to the right and looks at 3D reconstructed user B. User B does not move from the initial position.

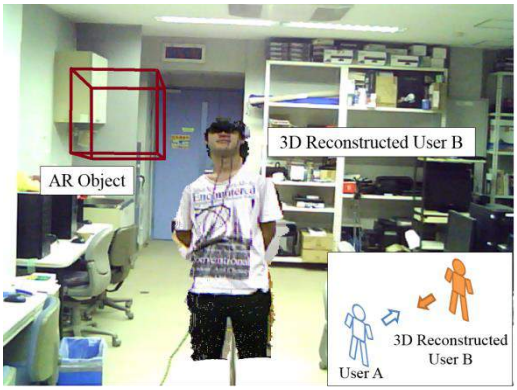


Figure 4(a). The initial state of the experiments. (User A view)

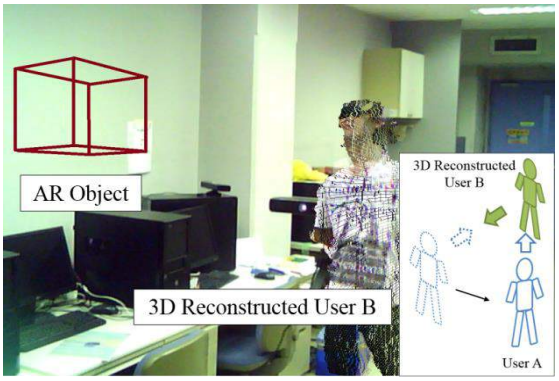


Figure 5(a). User A looks at 3D reconstructed user B at the right side.

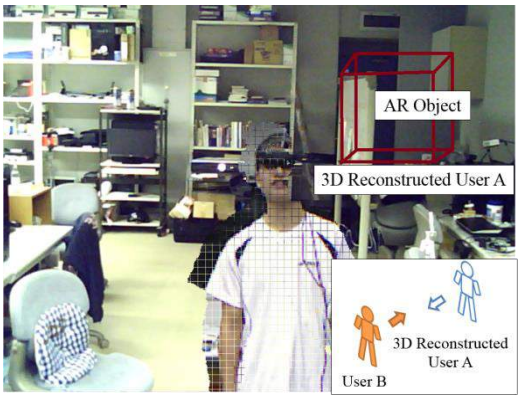


Figure 4(b). The initial state of the experiments. (User B view)

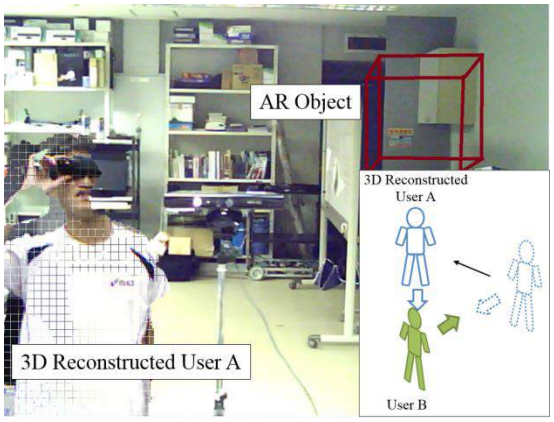


Figure 5(b). User B looks at 3D reconstructed user A from the initial position.

3 PROPOSED APPLICATION

In this study, we develop an application to intuitively transfer data. This application is that data is transferred by handing the AR object in the AR space.

Figure 6 shows the flow of the processing of this application. This process is divided into "Contact Judgement", "Processing of the Sender" and "Processing of the Receiver".

Moreover, Figure 7 shows the steps of application execution. Figure 7(a) shows the stand-by state. First, the sender grips the virtual data object in AR space (Figure 7(b)) and holds out it to the receiver (Figure 7(c)). The receiver grips it (Figure 7(d)). Kinect detects these actions. Then the sender's PC sends data and the receiver's PC receives the data.

3.1 Contact Judgement

This Processing is to judge whether the users are gripping the AR object in the AR space. Figure 8 shows the range of contact judgement. Each PC judges whether coordinates of the left hand obtained from Kinect $\boldsymbol{H} = (H_x,\ H_y,\ H_z)$ is within the range of coordinates of the AR object $\boldsymbol{A} = (A_x,\ A_y,\ A_z)$ by using

$$\|\boldsymbol{H} - \boldsymbol{A}\| \leq R, \qquad (1)$$

where R is the distance from center to surface of the sphere which is a judgement range. The judgement range is larger than the AR object. Each PC sends and receives the judgement result to each other. If both users satisfy the contact judgement, the sender's PC proceeds to "Processing of the Sender" and the receiver's PC proceeds to "Processing of the Receiver". Unless both users satisfy the contact judgement, both PCs proceed to the next process without transmission file.

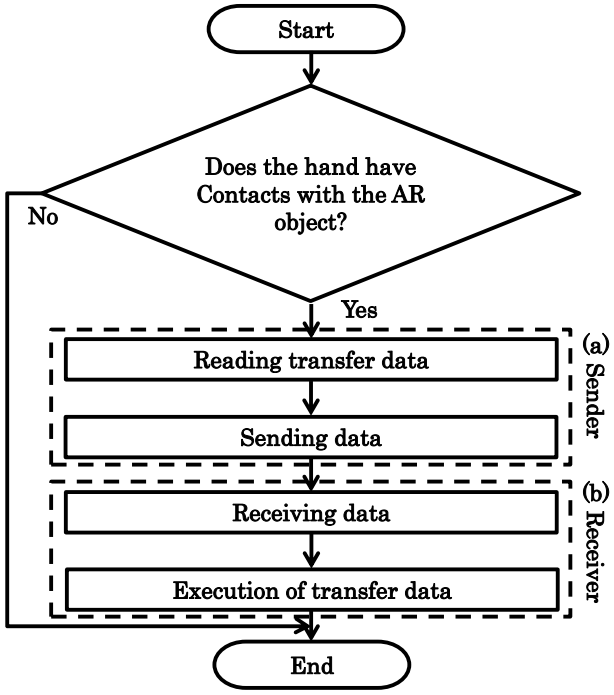


Figure 6. The flow chart of the data transfer function.

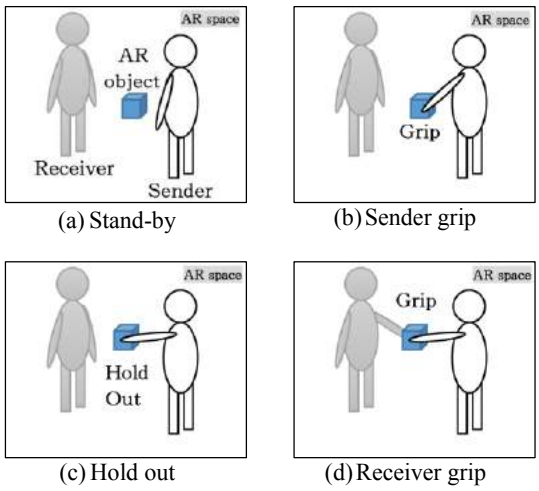


Figure 7. The steps of application execution.

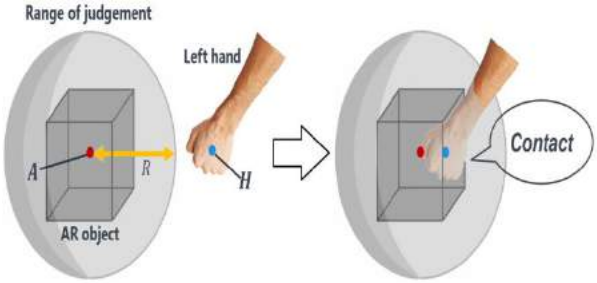


Figure 8. The range of contact ju.

judgement

3.2 Processing of the Sender

Figure 9(a) shows stand-by state at the sender's side in the application. The send file is displayed at left side. The sender grips the AR object (Figure 10(a) and (b)). Next, the receiver also grips the AR object (Figure 11(a) and (b)). If both users satisfy the contact judgement, the sender's PC obtains the filename from purpose-built directory. Next, the sender's PC writes the filename to the socket. After sending the filename, the sender's PC reads the file contents by using the filename. Then the sender's PC writes sequentially the read contents into the socket.

3.3 Processing of the Receiver

Figure 9(b) shows stand-by state at the receiver's side in the application. If both users satisfy the contact judgement (Figure 11(a) and (b)), The receiver's PC reads the filename sent by the sender, and creates a new file in the read filename. Next, the receiver's PC writes file data written sequentially to the socket into the file. After receiving, the receiver's PC creates an object for execution in AR space. If the receiver's left hand contacts the object for execution, receiver's PC executes the received file. It is possible to confirm the transfer by executing. Figure 12(a) and (b) show the scene that the receiver executes the received file. The received file is executed and displayed at left side.

4 EVALUATION EXPERIMENTS

4.1 Outline of the Experiments

We had an evaluation experiment using the proposed application. After 2 users are divided into the sender and the receiver, they transfer data. The sender grips and holds out the AR object to the receiver in the AR space. The receiver grips the AR object which is held out by the sender. After receiving, the receiver contacts the object for execution in the AR

(a) Sender's view **(b) Receiver's view**

Figure 9. Stand-by state.

(a) Sender's view **(b) Receiver's view**

Figure 10. The sender grips the AR object.

(a) Sender's view **(b) Receiver's view**

Figure 11. Both users grip the AR object.

(a) Sender's view **(b) Receiver's view**

Figure 12. The receiver executes the received file.

space. After contact to the object for execution, the receiver's PC executes file transfer application.

10 people performed the experiment. After that, they evaluated following items.

① Was it easy to grip an AR object?
② Was it easy to pass the AR object to the other user?
③ Was it easy to contact with the execution object?
④ Did you feel this system is intuitive?

Evaluations are 5 levels as the highest 5.

4.2 Experimental Results

Table 1 shows the result of the experiment. All average scores from ① to ④ are higher than 4.0. Moreover, all standard deviations are lower than 1.0. Among all the items, the item ④ is the highest average score and the lowest standard deviation. The item ③ is the lowest average score and the highest standard deviation.

4.3 Discussion

From the item ① to the item ③ are the items about the operation. Among these three items, the average score and the standard deviation of the items ① and the item ② are matched.

However, the average score of the item ③ is lower than the other two. Moreover, the standard deviation of the item ③ is higher than the other two. For these reasons, it turns out that there is the intense variation in the answer of item ③. We consider that there are two reasons. The first reason is to display the object for execution of received file at right side of the receiver. The second reason is that 3D reconstructed model is displayed in front of the image from the HMD. Therefore, when the receiver contact left hand to the object for execution at right side, receiver feels difficult to get a sence of distance because the left hand is behind of 3D reconstructed model. In order to solve this problem, it is necessary to devise a new display method of the background image in the future.

Because the average score of the item ④ is high and the standard deviation is low, it can be said that most people feel this application has highly intuitiveness in data transfer.

Table 1. The result of experiments.

No.	①	②	③	④
Average score	**4.20**	**4.20**	**4.10**	**4.60**
Standard deviation	**0.75**	**0.75**	**0.94**	**0.79**

5 CONCLUSION

In this paper, we showed the outline of the 3D video communication system using Kinect and HMD. Moreover, we implemented and evaluated the intuitive data transfer application for this system. As the result, we found this application has highly intuitiveness. However, we found the problem of the distance sensing. In the future, we would like to solve this problem. Moreover, we would like to implement a voice communication function and a system that can communicate with 3 or more people.

REFERENCES

[1] Kibum Kim1, John Bolton1, Audrey Girouard, Jeremy Cooperstock and Roel Vertegaal, "TeleHuman: Effects of 3D Perspective on Gaze and Pose Estimation with a Life-size Cylindrical Telepresence Pod", Proceedings of Chi'12 Conference on Human Factors in Computing Systems, 2012.

[2] Ryo Jozaki, "AR Chat: remote communication support system that uses augmented reality", The national convention of IPSJ, 2012.

[3] Avatar Kinect, http://marketplace.xbox.com/en-US/Product/Avatar-Kinect/66acd000-77fe-1000-9115-d8025848081a

[4] Hideyuki Hashimoto, Yuki Fujibayashi and Hiroki Imamura, "Development for 3D Video Communication System by Using Kinect and Head Mount Display in the AR Space", The International

Conference on Computer Graphics, Multimedia and Image Processing (CGMIP2014), 2014.

[5] Van Krevelen, D. W. F., R. Poelman, A survey of augmented reality technologies, applications and limitations., International Journal of Virtual Reality 9.2 (2010): 1.

[6] Lewis Napper, Winsock 2.0: Windows Socket Power Guide, John Wiley & Sons; Pap/Cdr edition (1997).

[7] OpenGL, https://www.opengl.org/

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OPTIMIZED ENERGY CONSUMPTION IN WIRELESS SENSOR NETWORK ROUTING BY GENETIC ALGORITHM

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ABSTRACT

The wireless sensor network is set of hundreds or thousands nodes, where each node is connected to one or sometimes several sensors. A WSN integrated circuits, sensor, embedded computing, modern network, Wireless communication and distributed information processing. Wireless sensor networks, a technology acquisition and processing of information. Recent developments in the course of it, in order to miniaturization and low power design. They act as a gateway between sensor nodes and the end user as they typically forward data from the WSN on to a server. Other special components in routing based networks are routers, designed to compute, calculate and distribute the routing tables. The project dealt with the problem of routing wireless sensor networks for energy balance. To optimize the solution, genetic algorithm is proposed. Key points when choosing the cluster center is proposed for placement algorithm. In this paper, the proposed standard algorithms, simulated results based on the parameters of the number of dead nodes, the number of bits transmitted to a base station, the number of bits sent to the heads of energy consumption compared repetitions and show superiority over the network the proposed algorithm is relative.

KEYWORDS

Wireless Sensor Network, Routing, Leach, Genetic Algorithm.

1 INTRODUCTION

Distributed sensor systems are capable of monitoring their environment safe. In this system, unlike traditional wired systems, on the one hand costs reduced configuration and network configuration instead of installing thousands of meters of wire on the other hand should only be a small device, about the size of the same coin. Wireless sensor networks (Wireless Sensor Network / WSN) is a wireless network of sensors are scattered and to measure self is said that a group of some physical quantities or environmental conditions such as temperature, sound, vibration, pressure, motion or pollutants, in There are a range of different locations. Sensor Networks motivated use in military applications such as monitoring the battlefield, was developed. But today, wireless sensor networks used in industry and many non-military purposes, such as monitoring and control of industrial processes, health monitoring devices, environmental monitoring and home health care applications, smart homes and traffic control6. In addition, one or more sensors, each node of the network is usually equipped with a radio transmitter and receiver (or other wireless communications device), a small microcontroller, and an energy source (usually a battery) 78 . The size of a sensor node depending on the size of the packaging has changed to be small one of sand is the microscopic parts of Kitty litter yet to be constructed. Similarly, the price of each sensor node can be between a few hundred dollars to a few cents, depending on the size and complexity requires a different node. Price and size constraints on sensor nodes leads to limitations in resources such as energy, memory, processing speed and bandwidth in them. A sensor network is usually the formation of a contingent of wireless networks (ad-hoc) gives, which means that each node uses multi-hop routing algorithm. (A large number of nodes and the central station will bring forward a packet). Currently, wireless sensor networks, a topic of active research in computer science and communication every year, numerous workshops and conferences held in this regard. In this article we will have a significant impact in reducing energy algorithms communication focuses on the network. According to our research, direct

transmission method and are not optimized for use in sensor networks910. We can LEACH is a clustering protocol based on a proposal that we can turn the head of a local clusters; energy consumption is divided between all nodes. Scalability and robustness of the algorithm that makes possible the local coordination and reduces data transfer, uses13. This algorithm reduces the energy of the 8 factors. The energy consumption of its distribution network to life. In direct communication, each node of your data directly to the station sends. If the station is remote nodes, a lot of energy will be spent on the transmission network nodes and greatly reduced life expectancy. However, if the station was close-knit, this method was acceptable and probably better. At least energy, the nodes are routed to the station using the intermediate nodes. Another method of clustering. Nodes in the cluster divided by each node communicates with your local station and the local station sends data to the public stations to eventually reach the hands of users. After clustering is energy-efficient1112. LEACH self-management algorithm, clustering is consistent with the random energy distribution between nodes in the network. Clustered nodes with a local station or the head. If the head is on a constant basis will be seen that with luck life decreases network. The algorithm says that heads randomly rotated continuously until the battery is not reduced between nodes. The algorithm uses local data to compress data transferred to the station. Each node in a specified time and with a certain probability, as is the top choice. The status of the other nodes in the network announced. Vertices of each cluster node receive the data collected and then compress it to the station sends. Details of the algorithm: LEACH is divided into two rounds. First-round set-up where clusters are formed and the second steady-state data transmission is carried to the station. It is better to reduce the overhead of the second round of the first round have more time.

2 A REVIEW OF THE LITERATURE

In the paper [1] the effect of multipath routing and flow divided on the efficiency of wireless mesh networks were studied. Three criteria were used to measure network performance include the network throughput, minimum bandwidth is allocated to the current fair and acceptable requests that require specific QoS bandwidth. Each of these criteria, in both cases using multi-path routing and flow divided on them without the use of multi-path routing is calculated. To calculate these measures, in each case provided an optimization model to solve them with the optimum amount of these criteria have been achieved. Comparison of these measures in the two cases indicated that even though the use of multi-path routing can meet these criteria in wired networks to wireless networks, but does not affect two-fold increase. In addition, comparison of the two state solution models showed that the use of multipath routing optimization model solution gives very easier. The juxtaposition of these two forms of the results obtained above this. 1) Multi-path routing and distribution. Cannot be used to increase the efficiency of wireless networks and its use has led to complex algorithms and protocols flora. 2) The use of multipath routing and the distribution network optimization models, on the one hand significantly reduced the complexity of the flora. The optimum amount of resolve, a band single rout reliable algorithms will be used in the network, because the optimum value with optimum results of the single-track model is no different. According to an article [2] Due to the limited bandwidth in wireless sensor networks and communication channels being shared among a large number of sensor nodes poses a serious problem comes to collisions. Packet collisions among the factors that increase the end-to-end latency in wireless sensor networks flora. Due to the collision, the nodes try to write this batch of would-be lost, the end to end delay increases. In this paper, we present a method in which the network graph in order to increase the capacity network built by XTC algorithm and then using a modified distance vector algorithm, production batch so that delays are the end-to-end routing is effectively reduced. XTC algorithm is one of the most realistic and the most practical control algorithms in wireless sensor networks is connectivity. In this algorithm, unlike many other algorithms, network nodes need to know your

exact geographical neighbors rate daily. In this algorithm in rugged environments, most applications of wireless sensor networks operating in these environments will be defined. Generally, this algorithm gives three steps to build a network topology that all nodes in the network, these three steps are the creation of neighbor sorted list, the exchange of the list neighbor, construct a graph network from the perspective of each node in the network. The results presented in this figure for the rate of 10 packets per second, respectively. The higher traffic loads, given that the two other methods of dealing with the increased severity of this issue are more acute. Many local searches in passive mode are used for routing problem. The work to minimum cost routing of a specific type of genetic crossover operator as PMX is used for each element of the population. Local search results in an overall analysis of the population in the preprocessing obtained once and is always a part of the population-have. The comprehensive analysis to find the optimal solution best local routing problem respectively15. The schedule is used to cool the temperature is logarithmic functions that lead to the optimal solution to this problem [3]. The routing problem, method for PMX crossover operator causes repeated occurrence node and hardware algorithm gradual cooling function is logarithmic, the rate of convergence of the local search algorithm.

Article [3] wireless sensor networks has been energy-based routing. The idea of this article, a method of balancing the energy consumption and increasing life is network. This difference with other routing protocols, instead of finding a way to keep track of lots so that, when packet to a node on the path seems, common neighbor exchange algorithm, the energy difference between the node and its neighbors out of the tree routing with the calculation stems. If it is greater than a threshold, then the descendants of a common neighbor exchange algorithm runs again. Also to prove the efficiency of the method presented in these paper two algorithms Shortest Rerouting (EERS) and Longest Rerouting (EERL) until the superiority of the method have been introduced to replace the two neighbors, the article mentioned that this show based routing. Paper [4] on the wireless network by routing optimization and data compression lots maximum life. They are solving this problem by introducing an estimation function, necessary and sufficient conditions to achieve the optimum distribution on a gradient algorithm are designed17. The selected model geometry based routing algorithms so that it is an acyclic graph consists deals path. Based on the geometric routing algorithms could be any node sends traffic to neighboring nodes are neighbors with the condition that the target is less than the distance to the target node. Using data compression, each node performs two functions for receiving data from node neither this. As raw data from a neighboring node by node and using local knowledge they are encoded for transmission of the nodes nearest neighbor nodes send data straight screw. Article [5] to introduce a monitoring protocol based on collective intelligence in sensor networks observer. Assumptions and definitions are the problem: there is no prior knowledge of the observer16. All network nodes with potential sources Potential to-be. There is no knowledge of the density data sources. Algorithm lots proposed as follows: at time zero, are the factors that include a leader and a follower sent to the network respectively. Leading their ability to write to the network. Nodes 1 and 6, gradient directly "with Nazr coordinated addressing. After the expiry of the node 1 at 2/1, followed by the network stems. Node 2, followed in time 2/1 has received and after the expiry of the time sent to the network 5/1 stems. Node 3, according to the above process for nodes 1 and 2 in 5/1 time and forward received pursuant to the novel sent by the node 4 Downloaded flora. Node 6, following the receipt of the zero screw. Node 6 after expiration, pursuant to the 6/1 Send stems. Node 4 second copy of slave nodes was 6 at the time of 6/1 and drop it stems. This paper shows that using particles and assume collective intelligence computing capabilities for small, limited storage space and low energy consumption, we can achieve maximum sensor life time14. How it works it is an active selection protocol by way with energy-efficient and energy balance remaining on each node of the network could be increased to a maximum lifetime. Tree leading to aim at the lowest cost nodes on paper [6] respectively. If it is an approach in which the routing table, with the help of local search

optimization results have been obtained by genetic algorithms. Environmental problem, the lattice of interconnected nodes in which a number of important loss nodes destination. In such a lattice dynamics with factors such as cutting off the connection between the nodes to the destination, the target nodes in a group of targets, adding nodes to the group's objectives.

3 METHODS

In this study is to optimize the routing of wireless sensor networks for energy balance was studied by genetic algorithm. In this regard, the mathematical model it is derived. Given the complexity of this solution with order polynomial time for it. So to solve this large-scale model of optimization methods are used.

Algorithm:
1. the sensors are randomly distributed in the area.

2. Classification sensors are the groups or so each group has a leader.

3. The optimal number clusters based on distribution between all sensors and minimizing energy consumption are chosen.

4. If the current node in the cluster to another cluster period will end.

5. Select the nearest part of the data center by implementing a genetic algorithm:

A. Create an initial population.

B. Crossover Operation

D. Mutation Operation

E. Elitism Operation

6. Go to Step 5 until all cluster nodes to find their optimum.

3.1 The initial set of algorithms

The values that are given below based on the best run. We run the simulation several times until the parameter values to adjust the algorithm to obtain the best conditions. The values of these parameters are: number of network nodes: 50, number of iterations: 3000, within a place to locate the nodes in the network: [0100], the packets sent: 6400 bits, the probability of selecting a cluster head node as 0.05.

3.2 Simulation environment

The project engineering simulation software MATLAB is done and the results that the resulting output are provided in the form of charts. The system uses a 2.5 and a Core i7 processor speed and memory capacity of 6 gigabytes. Because the proposed method of evolution. Therefore, the efficiency of the system used depends. This means that in a system with other specifications may get different answers.

3.3 Key functions in the algorithm Distance criterion for the selection of heads:

$$\text{distance} = \sqrt[2]{(S(i).xd - S(n+1).xd)^2 + (S(i).yd - S(n+1).yd)^2} \quad (1)$$

In this regard, the matrix S, specifications nodes in the hold.

S(C (min_dis_cluster).id).E = S(C (min_dis_cluster) .id). E - (ETX * (ctrPacketLength) + Efs * ctrPacketLength * (min_dis ^ 2)); (2)

Ctr Packet Length: length packets, dis: distance between nodes, EMP and ETX: weight ratio E: energy of a node.

4 RESULTS

To evaluate the algorithms, I introduced four key parameter values over the different runs, we show them. The first parameter is the number of nodes in the network is dead. The second parameter is the number of bits of each year to the base station. The third parameter, the number of bits sent to the head

and the fourth parameter, energy consumption is repeated over the network.

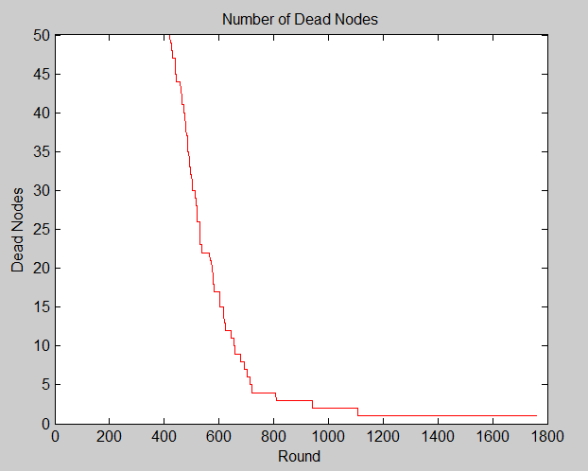

Figure 1. The number of dead nodes during run time of the proposed algorithm

Figure1 shows the number of groups which repeats over the die and the start value that is 50 to repeat 1100 reaches its minimum. The proposed hybrid method has better results than standard methods.

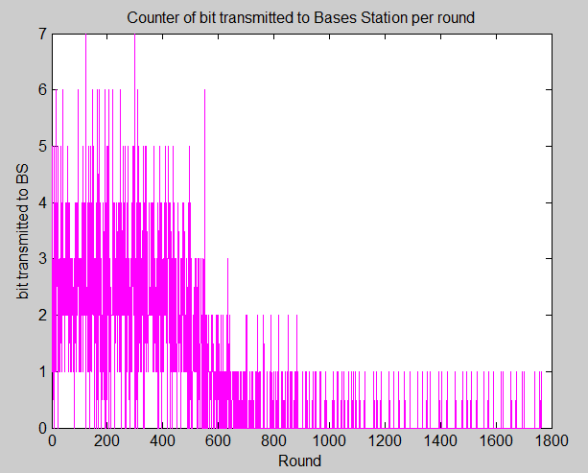

Figure 2. The number of bits transmitted to a base station at the proposed algorithm

According to Fig2, with the increasing number of executions, the number of bits transmitted to a base station decreased. The number of bits sent at a specified time interval, the network is a good criterion for assessing qualities. It is known that at the end of the run, energy and other affected nodes are not able to send the information. In the simulations carried out in the early run, swing it in there but the execution rate after 1800, many changes has been in almost a constant process.

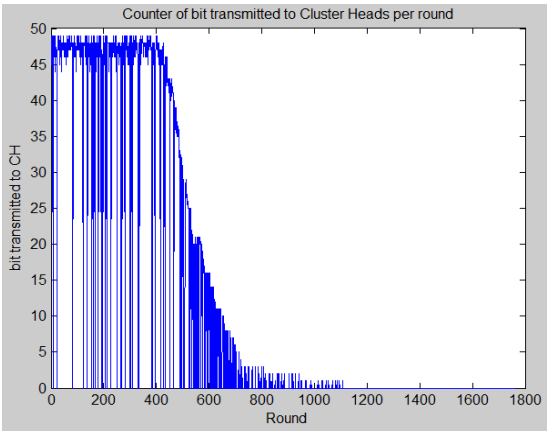

Figure 3. The number of bits sent to the head of the proposed algorithm

As shown in Figure3, with the increasing number of executions, the number of bits sent to the cluster nodes decreased. At the end of 1100 after running the numbers, reduced energy, and other nodes are not able to send the information. As the figure indicates the bits are sent to the cluster heads, the station is considered a general shop and shop locally considered as a result of fluctuations is less.

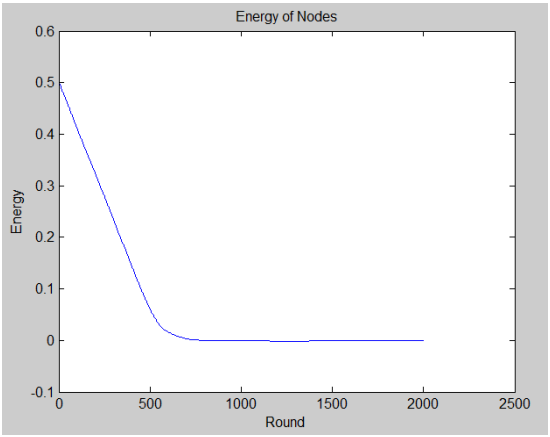

Figure 4. Network energy consumption during iterations of the proposed algorithm

In Figure4, total network energy consumption through increasing the frequency shown. Due to

the normalization is carried out; the amount of energy [0, 1] was calculated.

In Table1, the output parameters of the proposed method with article [1] are given. The article of gradual genetic makeup and hard to solve the problem is to use routing wireless sensor networks.

Table1. Comparing the results with other articles

Method	Energy of Nodes	of Counter bit transmitted to Cluster Heads per round	of Counter bit transmitted to Bases Station per round	Number Dead of Nodes
Leach	883	730	880	710
Leach-GA	1384	1110	1052	1005

Study of parameter values, show that the project is better than paper and more efficient solutions has earned. The number of bits sent to the heads of the algorithm is LEACH-GSA number of bits sent to the head and there was therefore conducted to compare these parameters with the standard method of wireless sensor network routing.

In this comparison we have tried to answer some convergence is starting in all parameters extracted for each algorithm is given in the table.

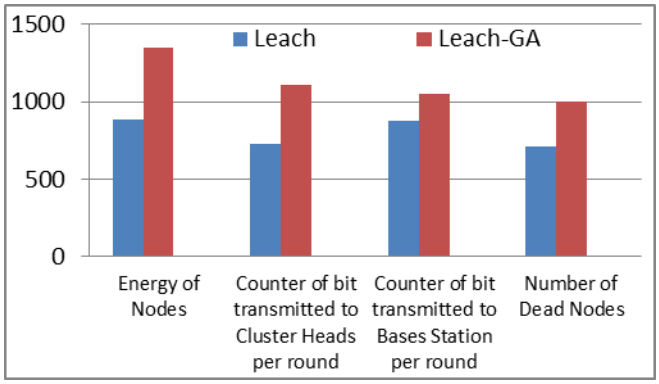

Figure 5. Graph algorithms are proposed to compare the results with each other

The chart in Figure5 shows in all criteria considered, wireless sensor network routing algorithm without optimization has values far above the number of dead nodes, the number of bits transmitted to a base station, the number of bits sent to the heads of energy network is used. In the graph below values, and therefore the results should lead to optimization algorithms have been proposed? Generations of evolutionary algorithms in the end to reach the optimal solution and an increase in the parameters of the genetic algorithm leads to better results will be achieved. But it is necessary in the hardware simulation program with high technical specifications and executed in parallel on multiple computers.

5 CONCLUSION

The project dealt with the problem of routing wireless sensor networks for energy balance. To optimize the solution, genetic algorithm is proposed. Key points when choosing the cluster center is proposed for placement algorithm. In fact, instead of the normal process of running the program, find the cluster center, the way it was proposed algorithm and determines the optimum location of the cluster center. Each sensor in the standard algorithm to generate a random number or not the decision of opening, CH. Due to the random selection cluster heads it is possible that in some times not part of the network nodes in another part cluster heads density is high. In the proposed algorithm, this problem is solved if the proposed algorithm is responsible for finding the position of the cluster centers. The standard method assuming the BRICS have nodes energy and thus nodes heterogeneous in terms of energy, provide full benefits. To solve this problem, we tried to set energy algorithm for the energy difference is clear. In this project, the proposed standard algorithms, simulated results based on the parameters of the number of dead nodes, the number of bits transmitted to a base station, the number of bits sent to the heads of energy consumption compared repetitions and show superiority over the network the proposed algorithm is relative, but still with optimal solutions are there. The hierarchical routing an

effective way to reduce sent to the base stations and increase lifetime is network. The proposed algorithm uses local data to be compressed and transmitted data station has resulted in an overall optimization. It seems that the proposed method is an evolutionary algorithm, local optimum solutions and answers can be found in the problem space. Therefore, it is recommended ways to solve this problem. In the simulation, the number of nodes from the start over the iterations of die and that 50 is the minimum number reaches 990 iterations. The value in sensor network routing algorithm standard achieved by the proposed method from the start that 50 is the number of nodes in a repetition of 1100 reached its lowest. The proposed method has better results than standard methods. The parameter number of nodes compared with 1050 is the result of articles that they have produced a better outcome of the project. Evaluation of network energy consumption during iterations of standard algorithms and suggested that the proposed methods for this parameter, do not have a good performance and the lowest was 550 repetitions.

Since the results of the proposed algorithm has not changed much over the standard algorithm. It is recommended to make changes in the proposed algorithm. One of the possible solutions, changing the parameters of the genetic algorithm is simulated, for example, the rate of mutation operators, cutting, elitism, size of population and initial values of temperature and speed of implementation will have any significant effect on the results. This is substantiated by the principle that the mutation rate is proportional to the variation in the population means an increase in mutation rate, there will be many changes in the chromosomes. Recommended. The next approach, combining simulated annealing algorithm and Tabu Search Algorithm (Tabu Search), respectively. Since the overall structure Tabu Search is often responsible for major issues. Therefore, in order to increase the strength of the algorithm candidate list strategies, strengthening, diversification, allowing integral solutions and combined with simulated annealing algorithm is used. The proposed algorithm can play a role when a cluster centers and the most favorable position to obtain the cluster center. We hope to develop this project, with solutions to achieve better results and less waste of energy in our total wireless sensor network nodes.

6 REFERENCES

1. Bakhshi B., Khorsandi S.: Optimal multicast routing in wireless mesh network and effects on network performance. CSICC, Paper_96, (2009).

2. Hajisheikhi R., Baharlo M., Mizanian K., Jahangir A.H.: Realtime and Effective Method Based on Topology Control for WSNs. CSICC, paper_83, (2009).

3. Zahrania M.S., Loomesb M.J., Malcolma J.A., Ullahc A.Z.M.D., Steinhfeld K., Albrechta A.A.: Genetic local search for multicast routing with pre-processing by logarithmic simulated annealing. Computers & Operations Research 35, 2049 – 2070, (2008).

4. Ding W., Iyengar S.S., Kannan R. and Rummler W : Energy equivalence routing in wireless sensor networks. Microprocessors and Microsystems, 467–475, (2004).

5. Yang H., Ye F. and Sikdar B. : Swarm intelligence based surveillance protocol in sensor network with mobile supervisors. Department of Electrical, Computer and Systems Engineering, Rensselaer Polytechnic Institute, Troy, NY 12180, (2004).

6. Rahbari D., Toosizadeh S.: Multi-Niche Crowding in a Steady State Evolutionary Algorithms for Dynamic Multicast Routing. International Research Organization of Computer Science (IROCS-IJCE) Volume (1): Issue (1), Published Online in IROCS Journals, (2013).

7. Vijayalakshmi K., Radhakrishnan S.: Dynamic Routing to Multiple Destinations in IP Networks using Hybrid Genetic Algorithm (DRHGA). International Journal of Information Technology Volume 4 Number 1, (2007).

8. Zahmatkesh A., Yaghmaee M.H.: A Genetic Algorithm-Based Approach for Energy- Efficient Clustering of Wireless Sensor Networks. International Conference on Network Communication and Computer, ICNCC, (2011).

9. Abo-Zahhad M., M.Ahmed S., Sabor N. , Sasaki S.: A New Energy-Efficient Adaptive Clustering Protocol Based on Genetic Algorithm for Improving the Lifetime and the Stable Period of Wireless Sensor Networks. International Journal of Energy, Information and Communications Vol.5, Issue 3, pp.47-72, (2014).

10. Leabi S.K., Abdalla T.Y.: Energy Efficient Routing Protocol for Maximizing Lifetime in Wireless Sensor Networks using Fuzzy Logic. International Journal of

Computer Applications (0975 – 8887) Volume 122 – No.1, (2015).

11. Rostami A. , Mottar M.H.: WIRELESS SENSOR NETWORK CLUSTERING USING PARTICLES SWARM OPTIMIZATION FOR REDUCING ENERGY CONSUMPTION. International Journal of Managing Information Technology (IJMIT) Vol.6, No.4 (2014).

12. Kumar K.V., Bhavani S.: An Effective Localization Based Optimized Energy Routing for Wireless Sensor Networks. Middle-East Journal of Scientific Research 23 (5): 915-923, 2015 ISSN 1990-9233 © IDOSI Publications, (2015).

13. Rahbari D.: Hybrid Evolutionary Game Theory in QoS Routing of Wireless Mesh Networks. International Journal of Computer Science and Telecommunications, Volume 4, Issue 9, (2013).

14. Sharma T., Tomar G.S., Gandhi R., Taneja S., Agrawal K.: Optimized Genetic Algorithm (OGA) for Homogeneous WSNs. International Journal of Future Generation Communication and Networking Vol. 8, No. 4, pp. 131-140, (2015).

15. Arya R., Sharma S.C.: WSN: Lifetime Maximization of Rumor Routing Protocol with Optimization Scheme and Bandwidth Evaluation. British Journal of Mathematics & Computer Science 7(4): 266-279, 2015, Article no.BJMCS.122, (2015).

16. Iqbal M., Naeem M., Anpalagan A., Ahmed A., Azam M.: Wireless Sensor Network Optimization: Multi-Objective Paradigm. Sensors, 15, 17572-17620; doi: 10.3390/s150717572, (2015).

17. Jiang J., Chen W., Liu J., Chen W., Zhang J.: Optimum Design of a Dual-Range Force Sensor for Achieving High Sensitivity, Broad Bandwidth and Large Measurement Range. IEEE Sens. J., 15, 1114–1123, (2015).

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Monitoring System for Residential Energy Consumption

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ABSTRACT

The aim of the present paper is the management of the energy-consumption of a residential building, where the addressed case is to figure out the trends of reducing energy consumption through many aspects like intelligent decisions making which is mainly based on good informed management. A leaky bucket problem is an analogous case to the proposed vision of the energy consumption, where it is essential to know the whole image of the leaky bucket contains some leaking openings and their corresponding locations and sizes before starting to close the leaks. Consequently, it is a mandatory phase to learn the energy-consumption system of a building before implementing any decision to modify or to improve the energy system under consideration. Concisely, the main objective of the proposal is to process to control the operation the consumption of energy for a residential system by considering real-time basis. Therefore by providing an information about electricity based on real-time at different levels for the utilization and consumption is the main goal of such control. To have a visual and right image of energy consumption that is undergoes in a building, a monitoring operation can give an excellent feedback. A framework to control the energy consumption as well as the smart management is adopted to achieve this goal.

KEYWORDS

Energy consumption, green building, monitoring; management, big data.

1 INTRODUCTION

Basically, there are many interpretations and meanings that the word "green" may imply. This term can refer to a range of meanings starting from preserving and protecting the originally nature and ended to switch off the illumination sources before departing the building, and in particular from the political catchphrases to the everyday habits of the individual, where assessing the potential of energy efficiency in the building is a very important intuitive to develop the energy policies [1], especially since the consumption of energy in big commercial buildings is considerably higher than in elsewhere sectors [2]. Therefore is so important and substantial to understand the links between global stability and the green energy-based sustainability through focusing on the main role of green energy to achieve global stability and sustainable development [3]. On the other hand, studying the status of electricity consumption for the main appliances and equipment, the energy efficiency progress, and estimates of the electricity-saving potential in residential sector is a great of interest as well [4]. The idea involves a lot of ideas and actions to be eventually green, environmental or even sustainable, like using recycled material, solar and wind energy [5], [6]. Mainly, towards saving natural resources of the earth and minimizing global warming, the efficiency of the energy consumption is one of the significant thoughts particularly through reducing fossil fuels burning. The energy consumption over the years if could be traced back, it might be illustrated that residential buildings are the main cause (International Energy Agency IEA) is exceeding the 40% of the world's energy consumption [7]. Growing of population and economy in the world, it is obvious that constructing buildings will continue. Therefore, the challenging query is by any mean to make or to adapt them to be as an efficiently energy? Numerous implementations can be done to achieve this task. One of these activities also can be designing green building [8]

that keep back energy due to well thermal insulation to manage between energy saving means. Studying and to improve efficiency, sustainability and reliability of the energy production, consumption and distribution have been carried out by many works. Generally, two parallel scenarios are considered in the energy domain to achieve efficiency. First, the supply side is under focus by the researchers, where the contributed thoughts were mainly concerned with introducing renewable energy sources such as wind, water and solar. These contributions were concluded by proposal of Amin and Wollenberg [9], where the management technology of the supply-side is named as smart grid. Digital processing and communication can be applied to improve sustainability as well as efficiency of the distribution and the production of energy [10]. Many researchers have demonstrated a joint vision of the future for the American electric delivery system smart Grid which is named as Gird 2030. The main goal of the second path, was to minimize the part of the demand-energy consumption, where it has been investigated by many researchers. Demand-Side Management DSM has been referred since the 1970s, where started to be implemented by US energy utilities for reducing the residential as well as demand through of the commercial electricity and numerous energy conservation trends. These trends can be information distribution programs, free installation subventions of further conserving technologies and equipment [11], [12], [13], [14], [15], [16], [17]. Basically, it is well known that at the beginning of the 1990's, formally the green-building movement has begun, which is intensely been driven by the effective use of many resources like energy and water and many others [18]. As aforementioned, the main part of the energy consumption of the world is the buildings and mostly up to 70% in few countries, like UAE based on the Middle East Centre for Sustainable Development. Numerous investigations regarding this issue has been discussed in the literature survey. In general, there are two scenarios mainly making the building more energy efficient. The first task is focused on how technique to design building to conserve energy, and secondly is thepart similar to the DSM programs, by the fact of focusing on the activities inside a building on how to manage and to operate the energy utilization [19], [20], [21]. An internationally accepted benchmark for high performance constructions (i.e., green buildings) is established by the U.S. Green Building Council (USGBC), which becomes a third-party certification program for the design, construction and operation, Leadership in Energy and Environmental Design (LEED) [22]. Actually, to focus on the design concepts of the building and not on the management of the energy consumption is the framework certification of the LEED program. Although LEED shows covering the management portion, it requires to be adapted to track and estimate of the real energy consumption in the considered buildings. As a matter of fact, the LEED tends to be more building-design frame rather than being energy consumption management, according to our classification of research contributions in energy efficiency at the level of building demand-side. However, to establish an evaluation process that evaluate and assess the influence of the design and operation practices on the real energy consumption in occupied buildings are considered as a genuine suggestion headed for LEED certification.

Our proposed software is a framework that gathers a pool of smart techniques that operate together in order to endorse energy efficiency through smart monitoring the real energy consumption and energy massive data analytics. As a result, an ongoing education toward energy conservation for the building occupants will be established. This contribution is an implementation of the suggested proposal to the LEED program. A rapid evolution in the monitoring and the analysis the energy utilization of the buildings with the purpose to control and decrease energy costs is highly observed, which is basically is the field of building energy management. By collecting data at hourly or any intervals via using automated meter reading approaches, can generate a large collection of data that requires analysis. Automated processing of this data can be done through using computer analysis through using machine learning techniques, invoking professional analysis where variances are detected. In general, machine learning continuously needs a

historic dataset to practice models and for establishing a benchmark for describing what founds an anomaly. Building performance simulation used by computer analysis uses physical concepts to guess energy performance, and permits the expectations of the activities of buildings from a pure simulation background. Through an image to the production of artificial bespoke benchmarks where historical outlines are not presented, [23] explored how building modelling approaches can be fused into energy management training. A real accommodation was monitored to collect and to estimate the precision of the method. It was revealed that machine learning from simulation models could have a high internal accuracy compared with the real metering data, which illustrated predictable errors in the system close to 20%, but attained a considerable improvement over industry benchmark values. Douglas [24] explained the main features that dynamic data-driven application systems (DDDAS), where A DDDAS is an application that has data assimilation that can modify the models and/or scales of the computation and that the application steers the data collection based on the computational results. He described what a dynamic big-data-driven application system (DBDDAS) toolkit necessity to have in order to deliver all of the substantial building blocks that are required to simply produce new DDDAS without re-creating the building blocks. A substantial efforts have been done by the City of Stockholm towards meeting its climate change commitments including a GHG emission target of 3 tonnes per capita by 2020 and making its new eco-district Stockholm Royal Seaport a candidate of Clinton Climate Initiative's Climate Positive Program.

Towards achieving these policies, [25] Shahrokni et al. evaluated the energy efficiency potential in the city, in collaboration with the district heating and electricity utility Fortum. A new understanding of energy use in the city emerged through drawing on their massive billing meter data on the housing stock in the city. The retrofitting potential of the building stock to current building codes can minimize heating energy used by one third. This revealed through analysis done of the energy efficiency potential of different building vintages.

It has been clearly evidence that big data has drawn massive attention from investigators in information sciences, policy and decision makers in governments and enterprises. However, the huge volume of data contains much potential and highly useful values hidden. A new scientific paradigm is born as data-intensive scientific discovery (DISD), also known as big data problems. On the one hand, Big Data is extremely valuable to produce productivity in businesses and evolutionary breakthroughs in scientific disciplines, which give us a lot of prospects to make great progresses in many fields, like energy monitoring and conservation. On the other hand, Big Data also arises with several challenges, such as complications in data capture, data storage, data examination and data visualization. Philip Chen and Zhang [26] demonstrated a view about big data, including big data applications, opportunities and challenges, as well as the state-of-the-art techniques and technologies we currently adopt to deal with the big data problems. It is also discussed several underlying approaches to handle the data deluge. Data management is being recognized as a significant bottleneck, regardless of whether data is stored in a cluster, grid, or cloud. Computing elements can be located far away from the data storage elements. One of the biggest issues in data intensive computing is the energy efficiency of the data centres storing this data. In order to report such matters, Vrbsky et al. [27] designed and analysed a series of energy efficient data aware strategies involving data replication and CPU scheduling. It was introduced a new approach for data repetition, named Queued Least-Frequently-Used (QLFU).and studying its performance to determine if it is an energy efficient approach. Moreover, studying the advantages of using a data aware CPU scheduling approach, named data backfilling, which uses job pre-emption in order to take full advantage of CPU usage and enables for longer periods of suspension time to save energy. The performance of QLFU was evaluated and existing replica strategies on a small green cluster to study the running time and power consumption of the strategies with and without data backfilling.

Outcomes from this investigation validated that energy efficient data management can shrink energy consumption without negatively affecting the response time. What is named U-Eco City, is a development and research project established by the government Korea [28]. Basically, the objective of the project was to monitor and to visualize of combined and real time states of numerous energy consumption habits that represented by location based sensor data accumulated from city to building scale. A platform's middleware was established into an advanced prototype and operative providing information to a Web-based client that interfaces and integrates with the Google Earth and Google Maps plug-ins for geospatially referenced energy utilization conception and monitoring. Large data was accumulated in all aspects. In general, thee advances in the technology of the sensors, wireless communication, internet and low-cost memory have mainly contributed to an bang of the big data. However, System of Systems (SoS) integrates independently operating, non-homogeneous systems to reach a higher task than the sum of the parts. At the present time, SoS is likewise contributing to the being of unmanageable big data. In recent times, efforts have settled a promising method, called "data analytics", which assumes statistical in addition to computational intelligence tools like as principal component analysis, clustering, fuzzy logic, neuro-computing, evolutionary computation Bayesian networks to decrease the size of "big data" to a controllable bulk, these tools can be used to information and form a knowledge base using the derived data, to develop a non-parametric model for the big data. Tannahill and Jamshidi [29] illustrated how to develop a connection between SoS and Data Analytics to establish consistent models for such systems. The aim is to use data statistics to develop a model to forecast made photovoltaic energy to help in the optimization of a micro grid SoS. through using tools like neural networks, fuzzy interference, PCA, and genetic algorithms. Big-data analytics is one of the most important applications of upcoming generation parallel and distributed systems . Data repositories for such applications currently go beyond exabytes and are speedily growing in scope. Beyond their sheer magnitude, these datasets and associated applications' considerations pose significant challenges for technique and software development. The size and privacy considerations of the distributed datasets is warrant distributed techniques. Usually with extensively changeable computational and network experiences, data often resides on platforms. Considerations of fault-tolerance, security, and access control are critical in numerous applications [30]. Analysis tasks often have hard deadlines, and data quality is a main concern in yet other applications. Basically, data-driven models and methods, capable of operating at scale, are unknown for most emerging applications. The validation of results is a major issue, even when known methods can be scaled. Characteristics of hardware platforms and the software stack fundamentally influence data analytics. Kambatla et al. [31] focused on the emerging trends to highlight the hardware, software, and application landscape of big-data analytics.

2 PROBLEM DISCRIPTION

As a matter of fact to address energy conservation is considered challenging and impressive. Basically, this issue becomes more interesting when relates its consequences to the human actions. Positive habits like turning off the illumination sources and the screen of the computer before departing the room is considered completely a human behavior. So establishing continuous education and competitions headed for preserving energy is the main task in this proposal. Helping building occupants toward conserving energy is the other consequent challenges which highlight the usage of the real-time program engineering and the interaction of the human computer. The following points can summarize the subsequent challenges:

(1) At dissimilar level of the building as well as at different time scales, a system to monitor the usage of energy is required.

(2) It is needed to establish a sensing and metering operations to acquire the energy utilization information at multi-level of the building. As a consequence, to establish the

infrastructure of the network to transfer the metered energy measures is included.
(3) To be sure that the communication between different instrumentations and installations, protocols are required.
(4) The energy consumption database (the historical data) must be developed and managed to represent the energy data.
(5) Automatic sensing and metering can generate which can be served to acquire energy outlines and most best practices in the direction of cost-effective energy management.

3 THE PROPOSED SYSTEM

Basically to give the aforementioned problems and challenges, the solution for energy conservation is strongly associated to the success in establishing an continuous education and competition among residents of the building in the direction of the energy saving. We proceed by two steps, in order to have a concrete solution. The first one consists in planning an architecture that groups the big image of the suggested solution. The goal of the first step to propose a framework for the management of the energy consumption that will be elucidated in the present paper. Though, the second stage consist of in establishing a high fidelity prototype that implements the adopted procedure on a certain building, the college of information technology building in the UAE University. The next stage is the goal of the instant upcoming work.
In the direction of an architectural design of the proposed scenario, the following points are accomplished. This is what can be considered as functional requirements of the energy framework.

4 REQUIREMENTS OF THE ENERGY FRAME WORK AND BIG DATA ANALYTICS

(1) Studying the installations and apparatus in the buildings with the most high consumption. The objectives and indicators of the energy conservation will be determined . Later on, it will be decided the granularity of metering and sub-metering. In the college, as an example, it can be metered the consumption at different levels.

(2) To determine the specification of the system (i.e., smart metering/sensing), as well as its scale and composition. At this stage, it will allow to speculate the essential equipment, like sensors and meters besides to the network infrastructure to communicate with the instruments.

(3) To design a database to save energy utilization data appropriate to the building structure and satisfying the energy management goals. This data base will be used to design the best energy consumption practices.

(4) Designing and developing a dashboard for visualizing the information of the energy consumption. This software application is going to offer a user friendly tool and customizable graphic charts user interface that enables the building residence to monitor the energy utilization at every specific time interval. Mainly that means monitoring at multi timescales and interest shapes the energy consumption. User outlines contain, simple occupant, lab technician, equipment maintenance agent, building manager, etc.

(5) To develop different protocols to seize and transfer energy data to the energy utilization database and to the monitoring dashboard. Eventual communication between sensors/meters will be responsible by these protocols.

(6) Supporting to make decision in the direction of energy preservation, design and developing a software tool is required. Data gained from the energy utilization database and study models of best practices will be used as inputs for this tool. These models are then will be adopted to gain the smarter measures to reduce energy consumption.

(7) Establishing the unit measuring of every system, which includes dashboard tool, network communication infrastructure, protocols, decision making support tool and energy database system. It is highly recommended to be sure that each individual system is well examined at this level of the proposed solution plan.

(8) Adopting integration to testing numerous systems in the building environment. This must include an integration of the dashboard, energy consumption database and the metering-sensing system, whereas a second integration will examine the decision making supporting tool and energy consumption database.

5 FRAME WORK STRUCTURE

The requirement and the analysis elicitation guided us the following architectural modules of the proposed framework:

Software monitoring application: It is real-time engineering tool that provides a spectrum of interpretations and illustrations that will send feedback to the user on instantaneous energy consumptions activities in the building. It is mainly a dashboard that observes a combination of nominated energy utilization gauges finally selected by the users .

Metering and sensing system: A metering and sensing system will be installed in the building which enables to acquire energy measures at numerous levels (e.g., having meters at cafeteria laboratory, office, classroom, etc.). This system is going to contain a communication protocols and network infrastructure.

Decision making and control system: This tool is a the second stage software that will analyze occasionally or per user need, the gathered data and signal abnormal energy utilization of the particular instrumentations or location. Infrequent utilization can be signed when becomes more than the expected consumption allocated, as an example, through the equipment technical specification. Furthermore, this useful tool will supports to take decisions to change activities, or to tune or upgrades installation.

Database of the energy consumption: The present database is critical to evaluate the building attitude and building occupants behaviors concerning the energy utilization. It will clearly show the influence of the best consumptions and taken readings to promote energy preservation. Besides, the collected information can be a appreciated input to train energy cost approximation model and to guess the energy needs. This can be done through adopting a novel model methods [32].

Educational component based on social media: This module is going to be responsible to share, publish and to discuss energy utilization and consumption issue as well as culture. It goals at launching a culture and education of energy saving among building occupants. Moreover, this element will test tweets and posts from social networks in order to collect energy data and learn negative and positive energy utilization patterns.

The big image of the proposed framework is illustrated in Figure 1. The major outline components and the relationship between them, can be caught in particular.

Without any negative concerns, the potential of application of this proposed framework is clearly visible. It can be applicable to a wide range of companies and firms, installations building, etc. In order to validate the framework and finally to develop it, it is proposed to establish an framework that consists of dashboard software application to monitor energy utilization of buildings in the university campus, as a model of the exist governmental buildings and installations. Moreover, the system can include even a wireless monitoring and control system for the gardens [33] to optimize water and energy consumption, since the region has big temperature difference between the seasons.

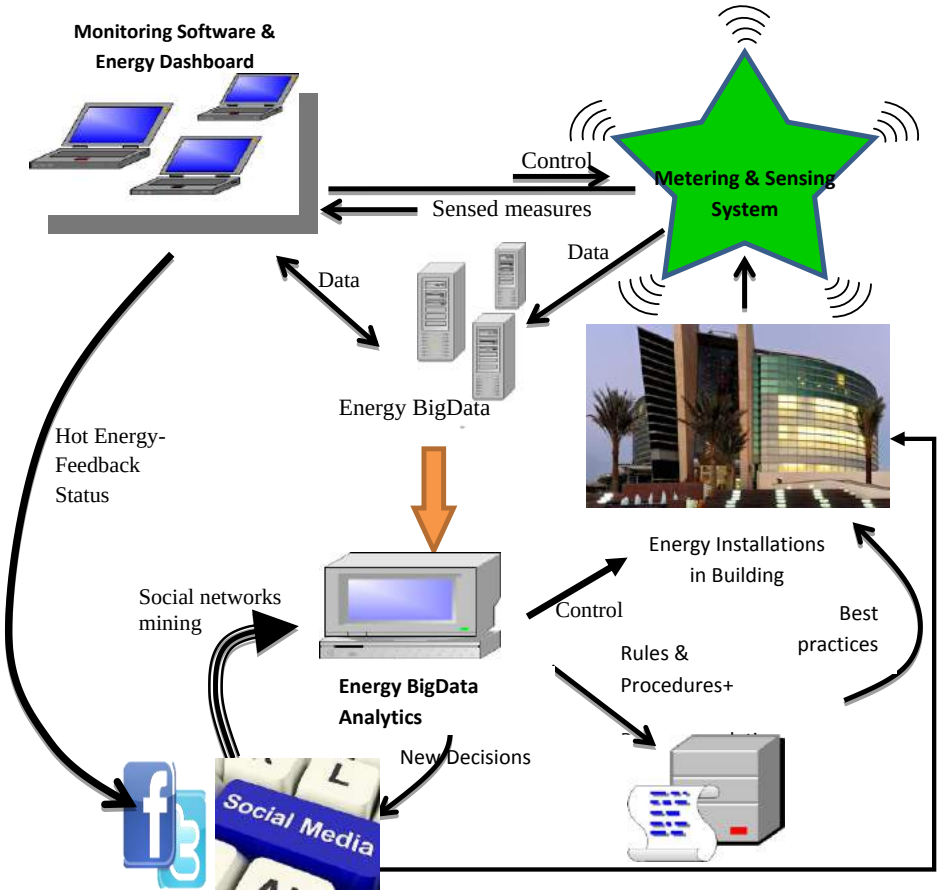

Figure 1. The proposed frame work.

6 CONCLUSIONS

One of the universal and crucial concern of our life if the energy conservation, since it is related directly the humanity. It remains a hot subject due to its several dimensions of the treated problem, although, it has been targeted by many researches and governments around the world from different aspects , renewable resources, supply-side, building construction area, demand-side , building occupants activities, etc.. Various trends and techniques can be used to bring support to energy utilization and consumption. In this work, Our main contribution to assist improving energy conservation via introducing a software based tools. Since it is initiated on the fact that energy preservation is connected to the behavior of the building occupants, therefore this challenge is extremely significant. We believe that it is a crucial and successful project to use the proposed framework scheme in order to report, inform,

avert or advice people. This is because it gives feedback and answers the residents enquiries and assists them to minimize their energy consumption. In general, The occupant is going to develop a self-evaluation process by being informed, and eventually a behavior modification toward energy conservation. This can be targeted by the proposed research challenge through the ongoing education. Implementing different software components will be the future work of the proposed energy management framework. Besides, framework customizations to different building specifications will be included as well.

7 REFERENCES

1. Bertoldi, P., Atanasiu, B.: An In-Depth Analysis of the Electricity End-Use Consumption and Energy Efficiency Trends in the Tertiary Sector of the European Union. International Journal of Green Energy 8, 306--331(2011).
2. Jiang, P., Tovey, K.: Improving The Energy Performance of Large Commercial Buildings in China Using Effective Energy Management. International Journal of Green Energy 10, 387--401 (2013).
3. Midilli, A., Dincer, I. and Rosen M.A.: The Role and Future Benefits of Green Energy. International Journal of Green Energy 4, 65--87 (2007).
4. Atanasiu, B., Bertoldi, P.: Latest Assessment of Residential Electricity Consumption and Efficiency Trends in the European Union. International Journal of Green Energy 7, 552--575(2010).
5. Ahmed, W.K.: Mechanical Modeling of Wind Turbine: Comparative Study. International Journal of Renewable Energy Research 3(1):94--97 (2013).
6. Almi, M.F., Arrouf, M. ,Belmili, H., Boulouma, S., Bendib, B.: Energy management of Wind/PV and battery hybrid system. International Journal of New Computer Architectures and their Applications 4 (1): 30-38 (2014).
7. Howe, J.C.: Overview of green buildings. National Wetlands Newsletter 33(1): (2010).
8. Al-Rifaie, W. N., Ahmed, W.K., Ibraheem, L.E., Al-Samarraie, H.Y.: The Use of Renewable Energy in Ferrocement Eco-Housing System. International Journal of Renewable Energy Research 4(1)151--158 (2014).
9. Amin, S.M., Wollenberg, B.F.: Toward a Smart Grid. IEEE P&E Magazine 3(5): 34--40 (2005).
10. U.S. Department of Energy. http://energy.gov/oe/services/technology-development/smart-grid (2015).
11. Electric Power Research Institute (EPRI). Demand Side Management. 1:Overview of Key Issues. EA/EM-3597. Palo Alto, CA. (1984).
12. Kito, J.S., Shown, L., Sonnenblick, R.: Where Did the Money Go? Cost and Performance of the Largest Commercial Sector DSM Programs. LBNL-38201. Berkeley, C.A: Lawrence Berkeley National Lab. (1995).
13. Fickett, A.P., Lovins, A.: Efficient Use of Electricity. Science 263, 64--74 (1990).
14. Geller, H., Attali, S.: The Experience with Energy Efficiency Policies and Programs in IEA Countries: Learning from the Critics. IEA Information Paper. Paris, France. (2005).
15. Gillingham, K., Newell, R., Palmer, K.: Energy Efficiency policies: A Retrospective Examination. Annual Review of Environment and Resources 31, 161--192 (2006).
16. Loughran, D., Kulick, J.: Demand side management and energy efficiency in the United States. Energy Journal 25(1):19--44 (2004).
17. Ji Y., Plainiotis S. Design for Sustainability, Beijing: China Architecture and Building Press. (2006).
18. U.S. Environmental Protection Agency. Green Building Basic Information, October 28. (2009).
19. Anastas, P.L., Zimmerman, J. B.: Through the 12 principles of green engineering. Environmental Science and Technology March, 95--101 (2003).
20. Rossi, M.: Innovative Façades: Lightweight and Thin Systems with High Inertia for the Thermal Comfort Application in Office Buildings in Southern Europe. Journal of Green Building 6(2):107--121 (2011).
21. Hay, A., Parlane, R. Okanagan College Centre of Excellence in Sustainable Building Technologies and Renewable Energy Conservation. Journal of Green Building 6(1): 4--24 (2011).
22. Baylon, D., Storm, P.: Comparison of commercial LEED buildings and non-LEED buildings within the 2002-2004 Pacific Northwest commercial building stock. ACEEE Summer Study on Energy Efficiency of Buildings, American Council for an Energy-Efficient Economy (Washington DC, USA) 4--1 (2008).
23. Wilde, P. de, Martinez-Ortiz, C., Pearson, D., Beynon I., Beck, M., Barlow N.: Building simulation approaches for the training of automated data analysis tools in building energy management. Advanced Engineering Informatics 27, 457--465 (2013).
24. Douglas, C.C.: An Open Framework for Dynamic Big-Data-Driven Application Systems (DBDDAS) Development. Procedia Computer Science 29, 1246--1255 (2014)
25. Shahrokni, H., Levihn F., Brandt, N.: Big meter data analysis of the energy efficiency potential in Stockholm's building stock. Energy and Buildings 78, 153--164 (2014).
26. Philip Chen, C.L., Zhang, C.Y.: Data-intensive applications, challenges, techniques and technologies: A survey on Big Data. Information Sciences 275, 314--347 (2014).
27. Vrbsky, S.V., Galloway, M., Carr, R., Nori, R., Grubic, D.: Decreasing power consumption with energy

efficient data aware strategies. Future Generation Computer Systems 29, 1152--1163 (2013).
28. Ah Kim, S., Shin, D., Choe, Y., Seibert T., Walz, S.P.: Integrated energy monitoring and visualization system for Smart Green City development, Designing a spatial information integrated energy monitoring model in the context of massive data management on a web based platform. Automation in Construction 22, 51--59 (2012).
29. Tannahill, B.K., Jamshidi, Mo.: System of Systems and Big Data analytics – Bridging the gap. Computers and Electrical Engineering 40, 2--15 (2014).
30. Dean., J., Ghemawat, S. MapReduce: simplified data processing on large clusters. OSD. (2004).
31. Kambatla, K.G., Kollias Kumar, V., Grama, A.: Trends in big data analytics. J. Parallel Distrib. Comput 74, 2561--2573 (2014).
32. Bouktif S., Ahmed F., Khalil I., Antoniol G. A novel composite model approach to improve software quality prediction. Information and Software Technology 52(12):1298--1311 (2010).
33. Kosmas Kapis, Mathias Ombeni: A framework FOR deployment of easy to use WIRELESS wireless sensors networks for farm soil monitoring and control: A case study of horticulture farms in Pwani region Tanzania. International Journal of New Computer Architectures and their Applications 5 (3): 107--118 (2015)

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Emergency Related Mobile Applications: Usability Framework and Proposed Implementation

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ABSTRACT

There are a variety of mobile applications that provide convenience to mobile device users and emergency related applications are one of them. The number of these emergency related applications has been increasing as people see the need for these applications. Many existing usability frameworks are meant for mobile applications in general. Applications of different functionalities especially emergency related applications might be evaluated differently when it comes to what factors are needed in it to be considered usable. Therefore, this research proposes a new usability framework that caters specifically for emergency related mobile applications according to the priority of usability factors needed in the application. Finally, an emergency facilities locater mobile application is proposed where the user interface design uses the guidelines derived from the new usability framework.

KEYWORDS

Usability framework, guidelines, emergency, mobile application, user interface design

1 INTRODUCTION

Research in user interface has been increasing due to the advancement of technology that has brought in numerous applications which have now shifted towards mobility. Mobile phones evolved greatly since its introduction in the mid 1980s [1][2]. The smart phone era started in the year 2002 with touch screen introduced in 2007 by Apple with the revolutionary iPhone. The perception of mobile phones changed especially with the rapid increase of mobile applications to suit those smart phones [2]. It produced a different and brand new way to use mobile phones and interact with them [3]. Aside from the operating system, mobile applications can be considered the heart of smart phones as without these applications, the smart phone does not contribute much in the lives of the people. As technology progress, mobile applications developed have increased in usefulness for many different areas in life. However, this has caused a decrease in usability where users find themselves facing small screen sizes, cognitive overload, high power consumption and limited connectivity [4]. These factors also pose a challenge to developers as these are the factors they have to consider when designing user interfaces for the mobile application. Usability is definitely important as it is a condition for survival. When an application fails to show its functions and purpose right from the beginning, users tend to abandon it [5].

Most researches on user interface and usability such as Nielsen's [6] rules on interface design gives a general guideline on how the interface of an application should be designed. However, with the increase in areas of usage for mobile application [4], more specific guidelines are needed along with their priorities for these applications. Different types of mobile applications might need to increase their focus on specific rules and usability qualities in their user interface to produce a better Human-Computer Interaction (HCI) and also to ensure that the main purpose of the application is fulfilled.

The main idea of this research is to analyze usability models and determine the factors that determine the usability of an application. From there, further analyze how those factors can be applied to an emergency related application. Therefore, the goal of this research would be to come up with a new usability framework and

propose a set of guidelines that would be used to design the user interface of an emergency related mobile application. This research would also show the priority of the usability factors in the context of emergency applications. The results of this research can be used to improve on the current applications available in the market and also serve as guidance for any future development of emergency related mobile applications.

2 BACKGROUND AND RELATED WORKS

An emergency is events that affect people, property or the environment negatively or a situation where things do not go as planned [7]. During an emergency situation, the two essential factors are the help needed to overcome that situation and the time taken for the needed help to arrive on site.

The rise of technology has changed the way people respond in an emergency. Previously, people would save the emergency contact number and call the emergency personnel when an emergency arises. In this case, reminders had to be given out to people to save the emergency contacts and many people still do not do it and are unable to contact emergency personnel in time. Nowadays, with the help of the Internet, people are able to locate emergency facilities and their contact numbers online and this enables people to respond more rapidly in event of an emergency. To add to that, mobile applications are getting more and more popular and there are applications with all sorts of functionalities, emergency applications included.

2.1 Rules for Interface Design

ACM's code of ethics [8] states that every individual in society regardless of race, sex, religion, age, disability, national origin and other similar factors should have equal opportunity to benefit from computer resources. This code of ethics reinforced the importance of the usability of a mobile application, which indirectly comes from its user interface design. Schneiderman [8] brought up a problem where computing technology has yet to reach the level of universal usability due to the difficulty of device usage where users waste 5.1 hours a week trying to use computers. Therefore, Jakob Nielsen [6] defined ten broad rules of thumb on an interactive user interface design, which are:

a) Visibility of system status: users should always be kept inform by the system through feedback.
b) Match between the system and the real world: the system should follow real-world conventions to make it more natural to the users.
c) User control and freedom: the system should support redo and undo actions.
d) Consistency and standards: unambiguous interpretation of each word, situation or action in the system.
e) Error prevention: avoid error-prone conditions, remove them effectively and provide confirmation for the user's actions to remove the possibility for errors.
f) Recognition rather than recall: information about the system should be visible and obtainable whenever needed so the user does not need to remember those information.
g) Flexibility and efficiency of use: a system that caters to both experienced and novice users.
h) Aesthetic and minimalistic design: each dialogue contains only needed information.
i) Help users recognize, diagnose and recover from errors: error messages should be put in simple language, indicate the exact problem and provide a solution to the error.
j) Help and documentation: steps on how to carry out the user's task should be provided.

2.2 Usability Challenges

Adipat and Zhang [9] and Anam et al. [10] pointed out the problems faced by mobile users from their devices:

a) Information overload: too much information in one screen at a time.
b) Limited memory of mobile devices: users need to remember the meaning of a command or action.

c) Navigation loss: trouble reaching the desired page.
d) Cumbersome input methods: small keyboards which require high concentration.

These problems pose a challenge to mobile users and may cause them to lose interest in using their mobile devices.

2.3 Existing Usability Models

There are many usability models in the literature. The usability models of Nielson, ISO and People at the Centre for Mobile Application Development (PACMAD) model are reviewed and compared in the following subsections.

2.3.1 Nielson usability models

Nielsen [5] and Zhang and Adipat [11] defined usability as a quality attribute that evaluates the ease-of-use of user interfaces. Usability is then defined through 5 components, which are:

a) Learnability: the level of difficulty for first time users when it comes to completing basic tasks of the system
b) Efficiency: speed of performing tasks once users become familiar with the system
c) Memorability: how much users can remember about how to use the system after a period of absence
d) Errors: the number of errors, the level of severity and the ease of error recovery
e) Satisfaction: the experience users obtain when using the system

2.3.2 ISO's Usability Model

Organization for Standardization (ISO) [12] defines the ISO 9241 process-oriented standards as the extent to which a product can be used by users to achieve specified goals effectively, efficiently and also be satisfied with the product. Therefore, the three components used to measure usability are:

a) Effectiveness: the degree of goal achievement users get from the system
b) Efficiency: the resources needed by the system to achieve the user's goals
c) Satisfaction: physical emotions felt by the user after using the system

This ISO standard requires a human-centered design approach to produce a usable and interactive system. However, measurements of usability is not limited having these characteristics in the system but also requires an evaluation of the performance and satisfaction of the users which creates a complex interaction between the users and the context of use of the system. This interaction produces three context characteristics of users, tasks and environment where a change in any one of these characteristics can definitely change the usability of the system.

2.3.3 PACMAD Usability Model

Harrison et al. [4] proposed a usability model that was inspired and improved from Nielsen's [6] and ISO's [12] usability model called the People at the Centre for Mobile Application Development (PACMAD) model. The PACMAD model aimed at producing a usability model that is more relevant to mobile applications and devices. This model is split into two relational parts that go hand in hand, which are the factors that influence usability and the attributes that reflect usability.

The three factors that influence usability are:

a) Users: a wide variety of users require different input methods depending on their physical limitations. The user's experience with the application also might require a different approach to be considered during the application's design.
b) Task: extra features added to the application's design might compromise the user's ability to achieve his or her goals with the application as it increases complexity and decreases usability.
c) Context of Use: the mobile application should be appropriate for different context usage such as physical locations and user interaction with people or objects. In other words, the environment in which the application is being used.

The seven attributes of the PACMAD model in evaluating the usability of a mobile application are:

a) Effectiveness: determined by the ability of the users to complete specified tasks.
b) Efficiency: productivity of a user in completing the tasks with speed and accuracy.
c) Satisfaction: the user's feelings towards the application such as comfort and pleasantness after usage of the application.
d) Learnability: the time taken for a user to become proficient in using the application.
e) Memorability: the ability of the user to maintain proficiency in using the application after a period of inactivity.
f) Errors: understand the nature of errors and preventing them from occurring.
g) Cognitive load: amount of concentration needed to use the application. This reflects the ability of the user to use the mobile application while carrying out other tasks and how does these other tasks affect the ability of the user to use the application.

Based on the three usability models reviewed and explained above, both the ISO and Nielsen usability models were created to serve as guidelines to improve usability in the area of user interface design of an application. All three models can be used when designing the user interface of a mobile application but the PACMAD model serves as a better and more thorough usability model as it was created with the intention of improving the usability of mobile applications specifically. It adapted not only the attributes of each usability model but also incorporated the three factors that influence the usability of a mobile application as was previously brought up by ISO. With the world increasing in pace as technologies head towards catering for convenience and the 'on the go' concept, it is vital that those factors and attributes be compulsory in all the mobile applications being developed. Therefore, the PACMAD model will serve as the main usability model reference for the next part of the research. It is an all rounded model and is more suitable in developing the proposed priority usability factors framework specifically for emergency related mobile applications.

3 METHODOLOGY

This section focuses on the methods that are carried out to obtain data for the research. The methodology starts with the collection of data. A questionnaire was created and given out to the target users. The questionnaire contained questions based on the usability factors in the PACMAD model to find out which factors matter most to the target users. After that, data from those questionnaires are analyzed to form the framework of usability factors for an emergency related application. Eventually, interpretation is done on the framework to come up with a set of proposed guidelines. Finally, an emergency related mobile application is proposed to demonstrate the use of the guidelines in its user interface design. The steps and outcomes are summarized in Figure 1.

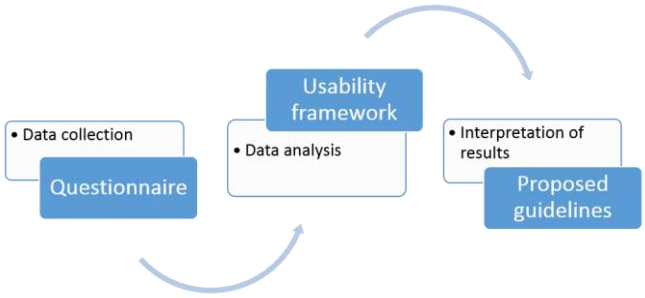

Figure 1. Research Process and Outcome

The population of this study is defined as mobile device users in Malaysia. The mobile devices are not limited to any particular brand or model and include smart phones, phablets (smart phones that are similar in size to tablets) and also tablets. The age group of the target users is between 16 to 65 years of age, disregarding gender. A quantitative approach is taken to collect data for this study through questionnaires using convenience sampling.
The mobile device users that aided in the research through their response in the questionnaires are chosen at random. Anyone within the target age group and who is willing to participate in this research will be given the questionnaires. This is because in this technological era, most of the people in Malaysia especially those who live in

urban areas own at least one mobile device or at least know what a mobile device is.

During the data collection process, a questionnaire with 16 questions is prepared. The questions are about the usability factors needed for emergency related mobile applications in particular. For each usability factor, there will be either one or two real life application questions. These questions do not directly state the usability factor but rather given situations in which the respondent is required to state their usual response. The final question of the questionnaire required the respondents to pick the five most important usability factors. The respondents were required to answer all the questions in the questionnaire. The questionnaires were distributed to the target respondents through social media and face-to-face.

4 RESULTS

A total of 82 responses were collected from respondents of various ages. The questionnaires are grouped according to the following age groups:

- 16 - 24 years old
- 25 - 30 years old
- 31 - 49 years old
- 50 - 65 years old

The reason for the age groups is because each age group represents the different generations in society. They have different levels of familiarity with technology and have different perspectives when it comes to what usability is. Different age groups have a variety of opinions and reasoning as to what makes a mobile application easy to use or satisfying enough.

The responses are analyzed to obtain the usability factors that determine the usability of emergency related mobile applications specifically through its user interface design. The results of the data analysis would be the five usability factors that the respondents feel are most important when it comes to using emergency related applications. Only the top five factors are chosen as these five factors represent the 'must-haves' for emergency applications. Usability is subjective as it differs according to the opinions of each individual user. Hence, these are the factors that are important in relation to the nature of the application.

From the results of the analysis, a final framework will be proposed to model the usability factors that cater specifically for emergency related applications. The produced framework will serve as a basis for the proposed user interface design guidelines that will eventually answer the main question of this research study, which is about the user interface guidelines for emergency related mobile applications.

The data obtained is separated into two parts. The first part is the data obtained from analyzing the importance of each usability factor from the questions that are related to the usability factor. These questions do not directly state the usability factor but instead, emphasize an individual factor each and also how it is applied in the mobile application. Most of the questions for this part ask about the reactions of the respondents given a certain scenario, which indirectly focuses on a particular usability factor. Table 1 shows that most of the respondents regardless of age place a high level of importance on the factors Efficiency, Effectiveness, Satisfaction, Learnability and Errors Handling.

Table 1. Importance of Usability Factors by Age Group

Age Group	16-24	25-30	31-49	50-65	Grand Total
Effectiveness	46	12	13	7	78
Efficiency	45	10	12	7	74
Satisfaction	33	10	9	6	58
Learnability	35	10	9	7	61
Memorability	24	10	8	6	48
Error Handling	30	7	7	6	50
Cognitive Load	17	5	5	1	28

The second part is the data obtained from the last part of the questionnaire where the respondents are required to choose the top five factors that they deem most important when it comes to an emergency related mobile application. The question is direct and the definition and explanation for each usability factor is given to the respondents for them to understand better. Figure 2 shows that the top five usability factors chosen are Effectiveness, Efficiency, Satisfaction, Learnability and Error Handling.

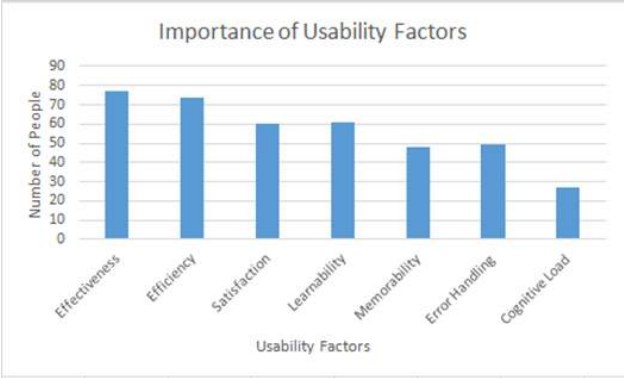

Figure 2. Overall importance of usability factors

This shows that the results are consistent with Table 1. Even with direct or indirect questions, the same factors are of utter importance.

5 DISCUSSION

With the top five usability factors selected by the respondents, a framework can be proposed. This framework shows the five usability factors that all emergency related mobile applications must have. To omit any one or more of these factors will greatly reduce the usability of the given application. The framework is shown in Figure 3.

Figure 3. Framework of Usability Factors for Emergency Related Mobile Applications

A set of guidelines for user interface design of emergency related mobile applications is drawn from the proposed usability framework. Each usability factor in the framework is elaborated to show how it should be applied in real application development. The following guidelines are set according to the order of usability factors in the proposed framework. The guidelines are:

a) The user interface should be designed in a way that it helps users to learn and fully utilize all the functions of the mobile application. The interface should have just the right amount of functions and options in one screen but yet remain its simplicity so that the user catches the meaning of each function and how to use them fast. The users must be able to complete the tasks they intend to do before using the application.
b) The user should be able to perform a function and complete it with minimal screen changes without compromising on the number of information in one screen. The faster and more accurately the user is able to successfully complete the tasks, the more efficient the application is fulfilling its purpose during an emergency. This can be done through a direct and simple user interface design.
c) Each user should have a feeling of contentment during and after using the application. The user interface should contain layouts and designs that ease the user. Users should want to use the application again and again and be able to rely on it when the situation arises.
d) The user interface should consider users with different backgrounds and learning capabilities. Age plays an important role when it comes to learning abilities. The user interface should be simple and easy to learn for a variety of users.
e) Errors become a huge problem especially when faced by users who are not so proficient with the application or even a mobile device. Each application needs to come up with a proper error-handling interface to effectively assist the user in case of an error and also to ensure that the user does not give up interacting with the application. Unclear instructions or bad error handling layouts might cause an error to prolong even though it might be something simple thus turning the user away from the application.

6 PROPOSED IMPLEMENTATION

This section proposed a mobile application named ‘Help!’, an Android based emergency facilities locator. The aim is to demonstrate the use of the

guidelines obtained from the usability framework above in designing the user interface.

6.1 Background

During an emergency situation, every second counts. Usually, we have to wait to be rescued or helped after calling the '999' hotline as the call agent needs to make further contact to the appropriate emergency facility in the right location. Time can be saved if we can just call the nearest emergency facility directly. Furthermore, if emergency happens to us who are in an unfamiliar or new location, we usually do not aware of our exact location and the types of emergency facilities nearby. Many of us also find it challenging to notify our loved ones when we are in an emergency situation especially if we need to notify more than one person. It would be convenient if we can just press a button on our mobile phones and all our loved ones are notified about the emergency.

6.2 System Architecture – 'Help!'

Help! uses the mobile device's Global Positioning System (GPS) function to detect the current location. From that location, the nearest emergency facility type such as police station, fire station or hospital is displayed along with contact numbers, address and distance from current location. The chosen emergency facility can be called directly. The overview of the system architecture is shown in Figure 4.

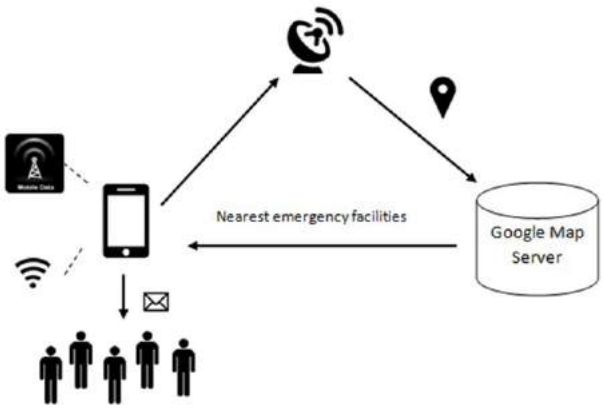

Figure 4. System Architecture of 'Help!'

Besides that, the application also allows five phone contacts and one emergency message to be saved. The emergency message will be sent to all five contacts when the 'Panic' button is pressed. The features of 'Help!' are shown in Table 2.

Table 2. Features of 'Help!'

Features	Description
Detection of current location	The system is able to detect the user's current location based on the GPS function in the mobile device
Allows selection of emergency facility type	The user can choose what kind of emergency facility is needed such as hospital, police station or fire station
Display all the nearest emergency facilities	The system is able to show all the emergency facilities and their details based on the current location of the user
Call the selected emergency facility	When the user chooses an emergency facility, the application dials the emergency facility directly without needing the user to type out the contact number
Save emergency contacts and an emergency message	The system will be able to save up to 5 phone contacts and also one emergency message. The user can also edit those contacts and message
Panic button	The system will send the emergency message using SMS to the saved emergency contacts when the button is pressed

6.3 User Interface Design – Help!

Based on the guidelines mentioned in section 5 above, the user interface design of 'Help!' is illustrated and described in the following subsections.

a) Main Menu

The main menu page as shown in Figure 5 is designed to ensure effectiveness, efficiency and satisfaction. All the features can be easily access in a single page with direct and simple design as mentioned in the guidelines.

Figure 5. Main Menu

b) Location of Emergency Facilities

Once the user selects 'Hospital' icon from the main menu, the list of nearest hospitals from the current location will be displayed along with the details as shown in Figure 6.

Figure 6. Location of Emergency Facilities

In Figure 6, the map above the list will be marked with the hospitals that are listed to show their exact position on the map. The blue dot is the user's current location. The interface is similar if user selects 'Police Station' or 'Fire Station'.

c) Dial Screen

Once the user selects the desired facility from the list in Figure 6, the dial screen will appear with the contact number as shown in Figure 7.

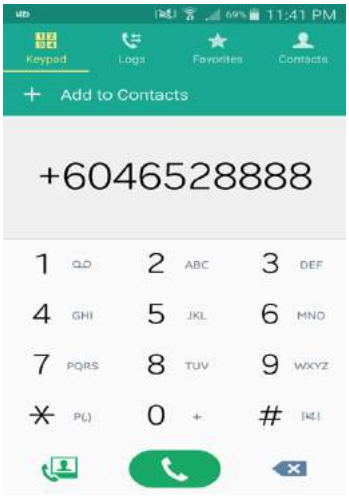

Figure 7. Dial Screen with Contact Number

User may choose to make the call by touching the 'call' icon or abort. This interface design gives great satisfaction to the user.

d) Current Location

When a user is at an unfamiliar location, the user can select 'Current Location' icon from the main menu. The user can then touch the 'zoom' icon at the top right of the screen to determine his/ her exact location on the map. The interface is as per Figure 8.

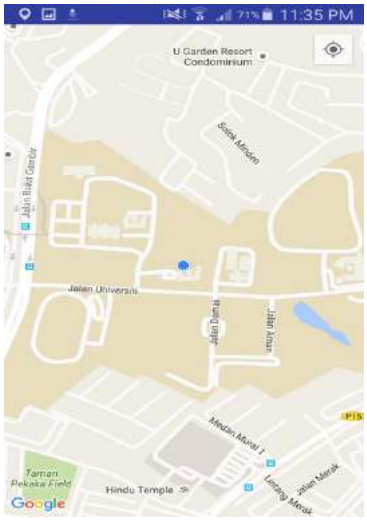

Figure 8. Current Location

e) Setting

The setting function is to allow the user to add/save/edit/delete emergency contacts or emergency message. The checkbox must be checked before pressing the 'Save' button to ensure the changes made are saved. A pop up error message 'Select the checkbox' will be displayed if the user press 'Save' without ticking the checkbox. The design of the interface is as shown in Figure 9.

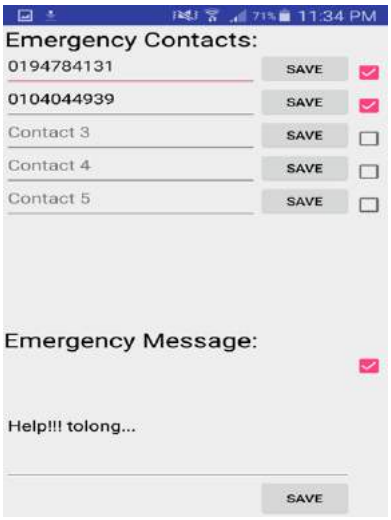

Figure 9. Setting

f) Panic Button

The panic button can only function if the user saved the relevant input in 'Setting'. Else, no notification will be sent.

6.4 Adopted Guidelines

The proposed user interface design has adopted all the guidelines and demonstrated that the new usability framework is practical and suitable in designing emergency related applications. Table 3 summarizes the adoption of the guidelines versus each interface design in 'Help!'.

Table 3. Adopted Guidelines

User Interface	Adopted Guidelines
Main Menu	a, b
Location of Emergency Facilities	a, b
Dial Screen	c
Current Location	a, b, c
Setting	a, b, c, d, e
Panic Button	e

7 CONCLUSION

The limitation of this research is that the findings cannot be generalized and the assumption is that the responses provided by the participants are true. Nevertheless, the findings provide quick guidelines to mobile apps developers on the factors that need to be focused on when designing emergency related applications, which have been well demonstrated in Section 6. This research has taken a more focus path than what normal usability researches did and contributed both in theory as well as practical implementation.

7 REFERENCES

1. Dyer, R.: How Cell Phones Have Changed Our Lives. http://www.personal.psu.edu/rtd146/383final.pdf
2. Osman, M. A., Talib, A. Z., Sanusi, Z. A., Shiang-Yen, T., & Alwi, A. S: A Study of the Trend of Smartphone and its Usage Behavior in Malaysia. International Journal of New Computer Architectures and their Applications (IJNCAA), 2-1, pp. 274-285 (2012)
3. Kinnunen, T.: Design of a user interface for a social billiards application for mobile operating systems. Thesis, Seinajoki University of Applied Science, pp. 9-13 (2013)
4. Harrison, R., ,Flood, D., Duce, D.: Usability of mobile applications: review and rationale for a new usability model. Journal of Interaction Science 1-1 (2013)
5. Nielsen, J.: Introduction to Usability. http://www.nngroup.com/articles/usability-101-introduction-to- usability/
6. Nielsen, J.: 10 Usability Heuristics for User Interface Design, http://www.nngroup.com/articles/ten-usability-heuristics/
7. Mobaraki, A., Mansourian, A., Malek, M., Mohammadi, H.: Application of mobile GIS and SDI for emergency management. Revue Francaise de Photogrammetric et de Teledetection, 185, pp. 95-100 (2007)
8. Shneiderman, B.: Universal usability. Communications of the ACM 43.5, pp. 84-91 (2000)
9. Adipat, B., Zhang, D.: Interface design for mobile applications. AMCIS 2005 Proceedings, pp.494. (2005)
10. Anam, R., Ho, C. K., Lim, T. Y. : Web content adaptation for mobile devices: A greedy approach. International Journal of New Computer Architectures and their Applications (IJNCAA), 1-4, pp. 1027-1042 (2011)
11. Zhang, D., Adipat, B.: Challenges, methodologies, and issues in the usability testing of mobile applications. International Journal of Human-Computer Interaction, 18-3, pp. 293-308, (2005)

12. Abran, A., Khelifi, A., Suryn, W., Seffah, A.: Usability meanings and interpretations in ISO standards. Software Quality Journal, 11-4, pp. 325-338. (2003)

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