Health Monitoring System for Ambulance Emergency System using Wireless Sensor Network

Asmaa Shaalan Abdul Munem

Computer Engineering Department, University of Mosul/ Iraq Email:al_princess90@yahoo

Dr. Muayad Sadik Croock 💿

Computer Engineering Department, University of Technology/Baghdad

Received on: 15/5/2016 & Accepted on: 29/9/2016

ABSTRACT

The health sensor is one of the technologies of the Wireless Sensor Network for Medical (WSNFM), which has a wide range of sensors that can be used to check a person's health data. In this work, a health sensor system is used to monitor a patient inside the ambulance along the way to the emergency department at a hospital. The system sends the vital readings to the emergency department using web based application and then save them in the server database. Two main types of sensors are used which are: body temperature and pulse rate sensors. The proposed system includes three main parts: hardware components at the ambulance, website, and SQL server at the hospital. The website is designed using ASP.net and PHP environments, while the database at the hospital is built utilizing SQL server 2012 in addition to visual studio C# for graphical User Interfacing (GUI). Simply, the readings of sensors are transferred from the ambulance using the internet throughout a website to the SQL server at hospital. The achieved results show a superior performance of the presented system in obtaining the designed target as well as high accuracy and efficiency.

Keywords: WSNFM, GSM Arduino shield, temperature, pulse rate, SQL server, PHP, C#.

INTRODUCTION

Recently, the electronic health applications are getting acceptance due to their reduction of caring expenses. Since ten years ago, both wired and wireless networking systems had been attempting to unify, provide efficient and dependable services to healthcare procedures [1,2]. In [3,4] is presents precise improvement for applying Wireless Local Area Network (WLAN). The monitoring of patients is not enough anymore, therefore it is important to take further actions to save life of them [5]. In the modern health monitoring schemes, the sensors' readings can be transferred through wireless technologies and categories. The development in different underlying technologies can provide efficient characteristics of speed and cost [6], in which the progress in development is rapidly increased [7].

There are different motivations to do research in this field. These motivations can be summarized as:

- Improve the life style for people.
- Providing efficient healthcare services remotely in ambulance, in which it continuously monitors and sends the vital information to the concerned hospital.
- Providing an efficient network algorithm.
- Programming web page and system in emergency departments for information accessing.
- Introducing notifications to doctors.
- Low cost, privacy and availability.
- Getting fast and precise medical support and information.

2877

https://doi.org/10.30684/etj.34.15A.9

2412-0758/University of Technology-Iraq, Baghdad, Iraq

This is an open access article under the CC BY 4.0 license http://creativecommons.org/licenses/by/4.0

- To digitize the system.
- Improve fast support for emergency situations.
- Secure system and taking into account privacy of patients.

Throughout this project, a system that encompasses all of the above techniques with new contributions is proposed. The ambulance unit measures the temperature, pulse rate of the patient and sends to the nearest hospital through GSM technology. The readings of sensors are sent firstly from ambulance to the web page and then such readings send to the server at hospital emergency department. This is to provide the emergency staff to prepare the required doctors and tools that can save the life of a patient.

Related works

A system in [8] proposed a designed medical monitoring system based on Zigbee technology. The proposed system could detect real-time body temperature, heart rate and other physiological information of the patient. These information were transmitted to a coordinator and then to a surveillance center through wireless network. The results proved that the error in body temperature, heart rate, and other information was very slight, which satisfies practical usage, and meets the demand of the design. In [9], the pulse rate and patient temperature are monitored along the way to the hospital. Another system represented in [10] consists of data communication networks, remote server, management/monitoring units, mobile care unit, monitoring of the biomedical signals from multiple patients. In [11], the authors provided a health monitoring of patients, suffered from high risk of distinct diseases. Thus, it deals with patients who should be permanently supervised. It is noted that the recent advances in computing technologies wireless communications have provided the flexibility of offering health monitoring.

System design

Figure (1) shows the proposed emergency health monitoring system design architecture. As mentioned earlier, the health devices contain a temperature and pulse rate sensors that read the living conditions through a patient's body in ambulance. The health data is collected and controlled using Arduino and in turns it sent by GSM Arduino Shield from ambulance to website. At the website, these data is stored in database server. Furthermore, the results from the web database can be viewed via a website in the form of a report in hospital and sent to the SQL server at the emergency department in a hospital.

The specifications of the hardware and software used in this work can be summarized as:

Arduino UNO Board:

The Arduino is a type of microcontrollers with known properties. Different accessories have been provided to the Arduino to be connected to a computer via USB port. The Arduino enables electronic process in multi-disciplinary projects to be more accessible. The companies introduce numerous shields that are connected to the Arduino to ease the interfacing. These shields have the ability of interfacing with other Arduinos and electronic devices as shown in Figure (2.A) [12].



Figure (1) System design architecture

Arduino GSM Shield:

The shield of Arduino GSM can provide mobile phone calls in addition to sending SMS messages and getting the GPS signals. It is installed to the Arduino and the selected mobile network SIM card is inserted to the shield to get the mentioned services as shown in Figure (2.B) [12].



A. Arduino.

B. Arduino GSM Shield.

Figure (2) Hardware Components [12]

Pulse rate Sensor:

Pulse Sensor is a heart-rate sensor for Arduino. It can be used by different users depending on the applications with numerous levels. The sensor is clipped to the patient's finger and plugged to the Arduino. It also provided a graph in time domain to simulate the pulse as shown in Figure (3) [13].



Figure (3) The Pulse rate sensor.

Temperature Sensor:

In Figure (4), The LM35 is temperature sensor that can transform the heat to electrical signals and digital readings [14]. The output voltage is normalized depending on the applications using specific equations.



Figure (4) the temperature sensor.

Database Building

Recently, An open-source relational database management system called Microsoft SQL server (MSSQL) represents a vital rule among all the databases in the world by performance, maintain security and compliance, and optimize your data platform infrastructure [15], [16]. In this paper, we build a database utilizing SQL Server Management Studio. SQL Server represent as a graphical management tool which is easy to using and dealing with it [17]-[19]. The underlying database, called "*sensors*", has been built in local SQL server that contains one table structure, for the patient information called "*PatientInfo*". The "*PatientInfo*" includes 9 columns as shown in Figure (5).

Another database called "*asmaasha_patient*" built in remote server called "*XAMPP*", includes one table structure called "*from sensor*" for saving data, obtained from health sensor through GSM Arduino shield. The table of "*from sensor*" includes 6 columns that are: *id*, which is represented a patient number in this table. Each row with the same *id* represents new reading

arrived from health sensor placed in ambulance for same patient. For example a patient with number of 33 in ambulance has two readings of pulse rate and two readings of temperature as shown in Figure (6).

- 4	patientes	patientiane	147	(an offer	racial/shulton	Bloot	address :		time	
1		Re been lies	12	Fereile	Single	10	inspiraled mana_	81/07/2015	(07)42 p	
. 16		inter widen	22	Male	Sage	48	manapart	30/03/2836	13.00+	
37			1	Male	Single	10	index street 2	30/03/2016	11.91 +	
15		ture meet and	53	7 arcale	Mainlast	U+-	enetys	30/03/2016	ш,	
39		need license	45	Ferasle	Mairied	0+	anwrya-	31/01/2016	13-0.	
30		interes of second	45	Melt	Morried	0+	177633	31/02/2016	11,0	
11		formed in second		Persale	Manual	D +	amanja	81/04/2018	13-42,	
22		acta alcrem alters	18	Male	Single	D+	tudia	83/94/2016	1246,	
12		di valeri jeseri	38	Male	Married	0.	longisted starse	29/96/2015	(14-14 p	
1		lete mothers a	3	Female	Single	U.	haghdad mans-	31/95/2015	10.48 +	
4		manar samery	44	Fernale	Maniat	D+	heghded 34 dt	81/06/2815	07.48,0	
1		jumana ali result	35	Fereale	Single	8-	heighted 34 str	81/07/2015	10.40 +	
		felah maheketi	58	Mate	Married	41	inspirated enteries	29/06/2013	12.00 -	
1		mahar materia	40	Male	Mannet	De .	tagfoled outlee	27/06/2015	مر NL151	
1		ion adviaval	л	Tecnals	Married	D+	liaghthed mana-	30/06/2015	551 e	
		Lakey Almed I	38	Allahe .	Noticed	48	Surgituled 24 sts	863.67215	10.52 -	
30		ile sea printer	168	Male	Married	48	heginized 34 str.	8011/2015	352+	
11		ripocal hadham	12	Fercale	Single	D+	bagtoled ensent	10/10/2015	07.54,6	
- 77		Fala taleni gesi	41	Feriade	Marriel	4.	inspiral arrest	10/11/2015	0.51.	
13		inter waited ga.	22	Fernale	Mainted	48	managine iscan	30/01/2036	06.12.4	
28		were read after	2	Parmala	Single	D+	mentous locati	86/02/2018	/0117.+	
1	-	P. N. H. St.	ň.	Facinate	Garde	-fl+	maintae 18 di	RUDOMA	08.14.a	

Figure (5) PatientInfo table

phpMyAdmin D + 0 0 0 free et tables free et tables transmine, 121 transmine, 121 transmine, 121 transmine, 121	Entered an analysis () the second and a line and a second a line and a second a line and a line an
a dereko, urbera	Bite Bit first form Bit Bit Reduct to complex B

Figure (6) Sensor table

Proposed Algorithm

The proposed algorithm composes of four main processes which were explained in the Figure (7) as a flowchart. These processes are: registration, updating, searching and request ambulance where each one is clearly explained as:

• Registration: This process is used to insert a new record to the *PatientInfo* tables.

• Updating: This process is done on the records that were already included in the database. To find the required record, a patient *id* or *patientname* of the required record can be used. This process can easily update any field of the whole profile.

• Searching: Here, inspection of a desired record can be performed by the searching process. As the updating process, a patient *id* or *patientname* of the required record can be used to search for that record.

• Ambulance: Can request any ambulance and insert a patient number to the database (from sensor) in remote server through a web page in website. Then, data from sensor is viewed using another web page.





Figure (7) Flowchart of the proposed algorithm

GUI Design

Visual Studio (VS) C# environment is utilized to design and implement the GUI of the proposed system. Using the VS C# as a designer application, easy dealing with the designed forms is guaranteed without requirements of skilled users. Figure (8) shows the system home page which involves four main buttons: Registration, Update, Search and Ambulance.



Figure(8) Home page of system.

When the user click on the "*Registration*" button, the personal information fields will appear. Here, the user can fill the fields before clicking on "*Save*" button as shown in Figure (9). This information is saved as record in the Patient Info table.

DATA ENT	RY FOR NEW PATLANT :-	AVE AUM	0
Ð	n.		4
NAKE	are altread sizes		
AGE		GENDER MA	LE • FEMALE
ADDRESS	transue street 16	STATUS CMA	RAIED SINGLE
DATE	10/0×22 H		
TIME	· · · · · · · · · · · · · · · · · · ·	HLOCO 10	¥1

Figure(9) New Record Insertion.

The update process is achieved when the user click on the "*Update*" button. The user can utilize the ID or NAME to obtain the required information that wants to be updated. The outcome of this process is the possibility of the user to update any field of the earned record in an easily series. Figure (10) shows the chosen profile based on its ID to updating it.

UPDATE FOR ANY PATLANT B.	ASED ON ITS ID	NUMBER OR	FULL NAME		
UPDATE IS BASED ON F	¥				
ID 14	UPDATE	HOME			
ofpoliontes putientesee age gr Califer Califert Califer Califert	adar sariabila Tegle	etine Mo	el address Venesse ison	date (jourtarizone	[05.13

Figure (10) Patient information updating

At the same manner, searching process was done by clicking the user on the "*Search*" button as shown in Figure (11). The obtained information is shown by doctor.

ł	MERGENCY DEPAR	IMENT	
SEARCH FOR ANY PATIANT BASEL	O ON ITS ID NUMBER OR FUI	L NAME	
SEARCH IS BASED ON :- NAME rule enter you	NAME -]	
Souther patienthame age geoder vertabilitation Hono Pata salou quin (41 (Prouzle) Married A=	address date time (myslinameter) (011/2011)(07/2011		

Figure (11) Search for any patient information

It is important to talk about main process in the proposed system which is the patient status in ambulance that contains three links. These links are: To Record Patient No. in Ambulance, View Status of Patient in Ambulance and Search for Any Patient as shown in figure (12). This page is connected to the designed website at the "*XAMPP*" remote server to save and view patient status in ambulance.

To Recored Patient No. in Ambulance Click here	
View Status of Patient in Ambulance Click here	
Search For Any Patient Click here	
HOME	
Search For Any Patient Click here HOME	

Figure(12) Home page of Ambulance.

Figure (13) show the website page that shows the saving of patient number in ambulance. This is to recognize the received readings from different ambulances at a time.

C () www.aomaichaidia/2016.com/www.monguerliambuhg	4 6 1
Patient No. :	
Patient No.	
Ambulance No.:	
860	
Address Of Patient	
Near to Al Sa'aa Restaurant	· •
Save	

Figure (13) Insert patient number to an ambulance

The link of *To View Status of Patient in Ambulance* is shown in figure (12) views the status of the underlying patient with a unique number in an ambulance as shown in figure (14). It is important to note that this page refresh itself automatically each 5 seconds.

		and the second second		and the second se		House House
Cit di manana	Annen alla com	Indust P + # B +++	autalas.com =			1.1
Patient No.	Pulse rate	Temperature	Time		Date	
	90	32	94:58:17	pm.	2016-04-22	
	99	112	04:58.18	(pm)	2016-04-22	
	<u>д;</u>	40	11:37:30	80	2016-04-24	
	-					
	0 0	(a) 12 1				Di - N 2 6 - 0112

Figure (14) View Status of Patient in Ambulance

In order to offer a searching option for doctors to a specific patient, they can enter the patient name or number as shown in Figure (15) and the outcome result is shown in Figure (16).

San Carlos				State of the local division of the local div		No. of Concession, Name
		104mt P + 0 0 4	riserisets over			A:* D
Rear Pro.						
-						
						10 + North Agend Antonia
		A DECK OF THE REAL PROPERTY OF				
		Fig	ure (15) S	earch ab	out patient	
A	A Contract of	Figu	ure (15) S	earch ab	out patient	Section Sec. And
e		Figu	ure (15) S	earch ab	out patient	n *(d)
Contraction of the second	arausaaran a	Fig	ure (15) S	earch ab	out patient	n • 0
Content for	urbuPalancan -	Fig	ure (15) S	earch ab	out patient	n * 0
Patant Na. Deserti Patant Patant	No. Pela rate	Figu	ure (15) S	earch ab	out patient	n • • (0
Patient III	No. Pulse rate	Figu	ure (15) S	earch ab	Date: 2016-04-24 2016-04-24	n •*'0
Patient Tec. Peatient Tec. Patient 1000 1000	No. Palse rate 27 27 27 27	Figu	ure (15) S	earch ab	Date Date 24	n • * (0)
Patient for Description 100 100	No. Palos rate 27 27 27 27	Figu	Time (15) S	earch ab	Date 2016-04-24	n **(0)
Control Contro	No. Palos rate	Figu	Time (15) S	earch ab	Date 2016-04-24	n */(0)
Control Contro	No. Palm rate	Figu	n Time 12 40 45 12 40 45 12 51 15 10 142 39	earch ab	Date 2016-04-24 2016-04-24	n */(d)
Control from Testing from Testing for Tool Tool Tool Tool	No. Palse rate	Figu	n Time 1240.45 1240.45 1240.45 1240.45	earch ab	Bate 2016-04-24 2016-04-24 2016-04-24	n */0
Control from Design from Design from Design from Design from Design from Design from Design from Design from Design from Design from Design from Design from Design from Design from Design from Desig	No. Palse rate	Figure Fi	ure (15) S	earch ab	Date 2026-04-34 2026-04-34 2026-04-34 2026-04-34	n */0
Control for the second	No. Palse rate 22 22 27	Figure Fi	ure (15) S	earch ab	Date 2016-04-34 2016-04-34 2016-04-24	n * 0
Control for Particular Particular 100 100	No. Palm rate 27 27 27 27	Figure Control of Cont	ure (15) S	earch ab	Date 2016-04-24 2016-04-24 2016-04-24	n • 0
Control for Beerf for Beerff Patient 100 100	No. Palm rate	Figure Control	ure (15) S	earch ab	Date [2016-04-34] [2016-04-24] [2016-04-24]	n • (d)
Control for the second	No. Polos rate 27 27 27 27	Tanyarahara	ure (15) S	earch ab	Base [2016-04-34] [2016-04-34] [2016-04-24] [2016-04-24]	n • (d)
Control Contro	No. Pelos rate 27 27 27 27	Figure Control (Control (Contro) (Contro) (Contro) (Contro) (Contro) (Contro) (Contr	ure (15) S	earch ab	Date 2016-04-24 2016-04-24 2016-04-24	n • • (d)
Contract for Trainert for Testinert 1000 1000	No. Pelos rate 27 27 27 27	Figure Control (Control (Contro) (Control (Contro) (Contro) (Contro) (Contro) (Contr	ure (15) S	earch ab	Date 2016-04-24 2016-04-24 2016-04-24	D . + . d
Contract from Testing 1000	No. Palar rate	Figu	ure (15) S	earch ab	Date 2209-04-24 2209-04-24 2009-04-24 2009-04-24 2009-04-24	D . + . 0
Control from Testing 1000	No. Palse rate	Figu	ure (15) S	earch ab	Date 2026-04-34 2026-04-34 2026-04-34 2026-04-34	n */0
Control of the second s	No. Pelos rate 177 172 177	Figure Control of Cont	Time (15) S	earch ab	Units 2016-01-24 2016-02-24 2016-02-24	

Figure(16) Results of searching.

Experimental Results

The proposed system is tested in terms of ambulance, website and emergency department database sides. A practical experiment is performed as shown in Figure (17), where the considered equipment and connections are illustrated.



Figure(17) Arduino Uno and GSM Arduino shield to send vital sign data for patient.

In emergency department, the insertion function of new record (patient) is following the steps explained in Figure (9). It is noted that the insertion process is done with high flexibility and efficiency. In order to test the updating process, we select the method of ID searching, for example the information of (ID=14) as explained in Figure (10). Using this process, all involved fields can be edited easily. For the searching process, the patient with the name (Hala Salem Qaus) is selected as shown in Figure (11). The first page, shown in Figure (18), inserts the patient's information to data base "*asmaasha_patient*". This page is requested by emergency department or patients to order an ambulance. Then this information is sent to the server of data center for processing the order. The ambulance number and patient number are chosen by system depending on availability and unique number. After the insertion, "*Save*" button is pressed.



Figure (18) Inserting a patient's information to data base "asmaasha_patient"

The second page, shown in figure (19), views the status of the underlying patient with a unique number in an ambulance. It is important to note that this page refresh itself automatically each 5 seconds.

Patient No.	Pulse vato	Temperature	Time		Date	
	110	29	10.45.00	lees.	2010-07-14	
	150	22	10-40.07	(pas	3616-67-14	
	1110	34	1/2:40:14	211	2016.07.14	
	110	19	10:40:23	200	2016-07-14	
	110	7.8	10.40.27	(90	2016-07-14	
	118	19.	20.42.31	(pea	2016-01-24	
	110	99	109-40-37	per .	2016-07-14	
	150	110	10.40.42	Ipes	2016-07-24	
	110	29	10:40:47	area .	2010-07-14	
	130	11	10-40-33	1000	3016-03-14	
	110.0	19	10.40.58	inta .	3616-07-14	
	110	310	10-41-04	1940	3010-07-14	
	120	39	10:43:52	201	2010-07-14	
	110	10	10.41.18	l pes	2016-07-14	
	(10)	11	10:43.23	pes a	2010-07-14	
	150	34	10:41:28	204	2016-07-14	
	1.00	39	20.45.33	ages .	2610-07-14	
	150	22	100-40.97	Ines	3616-67-14	
	110	34	101-41-42	2010	2816.07.14	
	110	117	110-41-47	1000	2016-07-14	
	110	14	10-41.52	1943	2016-07-14	
	1110	19	10.41.16	lana .	3846-01-14	
	110	19	101-42-02	per .	2016-07-14	
	LUG .	Da	110.47.08	Ines	12016-02-34	

Figure (19) View Status of Patient in Ambulance

Following the above processing, Figures (12)-(16) show the results obtained. It is well shown that the proposed system can perform efficiently and smoothly. The only problem can be pointed is the absence of internet service through GSM networks. In addition, the GSM networks and rented host server need a monthly or yearly subscribing that costs some money.

It is important to note that we need a permission from Ministry of Health to implement the proposed system in a real ambulance. This is can be considered as the big obstacle as this step needs more work on people knowledge and cultural level. Therefore, the above experiment has been done on normal car and the vital information is taken from real person setting there.

CONCLUSION

An emergency health monitoring system in an ambulance is proposed. This system can offer the vital information of a patient in an ambulance to be sent to the emergency department through internet using GSM network and website based data transmission. The doctors can interact with the patient and prepare the required equipment before arriving to the emergency. The presented systems include four main processes: Registration, Update, Search and Ambulance. Each of which can perform individually to produce a satisfied services to patients and emergency department. In terms of physical representation, the proposed systems include three parts: Hardware at ambulance, Website application and SQL database server. All these parts play turns in completing and achieving the planned objects of the work.

VS C# is used for designing the GUI of the system. In addition, ASP.NET and PHP were used to design the website and applications. Finally, SQL server 2012 was used for database management. The obtained results from the real-time experiment gave the confidence to implement the proposed system in real ambulance to handle the data transmission throughout different media.

REFERENCES

[1] A. Pantelopoulos, N. Bourbakis, "A Survey on Wearable Biosensor Systems for Health Monitoring", 30th Intl. IEEE EMBS Conf. 2008, Vancouver BC, pp.4887-4890.

[2] L. Gatzoulis, I. Iakovidis, "Wearable and Portable eHealth Systems, Technological Issues and Opportunities for Personalized Care", IEEE Engineering in Medicine and Biology Magazine, Vol.26, September/October 2007, pp.51-56.

[3] Evans, R. and N. Sarkar,"Mobile Commerce Implementation in the Hospital Environment: Issues, Challenges and Future Trends", Journal of Applied Computing and Information Technology, Vol 2, No 1, 2004.

[4] A. Pantelopoulos, N. Bourbakis, "A Formal Language Approach for multi-sensor Wearable Health-Monitoring Systems", 8th IEEE Intl. BIBE Conf., 2008, pp.1-7.

[5] Y.-F. Lee, "Personal Medical Monitoring System: Addressing Interoperability", IT Professional, vol. 15, no. 5, pp. 31–37, Sep. 2013.

[6] Jeong Gil Ko, Chenyang Lu, Mani B. Srivastava, John A. Stankovic, Andreas Terzis, Matt Welsh, "Wireless Sensor Networks for Healthcare", Proceedings of the IEEE, Volume: 98, Issue: 11, Nov. 2010.

[7] Anjali. E.V ,AbhinanthHaridas, Fasil. M.M, Jayalakshmi. P.K, "Data Transmission System in Ambulance", International Journal of Emerging Technology and Advanced Engineering, Vol 5, Issue 3, pp. 349-351, March 2015.

[8] Zhang Qing H., Wen X., Gao Xiang L., "Design of a Wireless Medical Monitoring System", International Conference on, Computer and Management (CAMAN), 2011.

[9] Bhandari Prachi, Dalvi Kasturi, Chopade Priyanka "Intelligent accident-detection and ambulance-rescuesystem", International journal of scientific & technology research, Vol 3, issue 6, pp. 67-70, June 2014.

[10] M. Abo-Zahhad, Sabahm. Ahmed, And O. Elnahas, "AWireless Emergency Telemedicine System for Patients Monitoring and Diagnosis", International Journal of Telemedicine and Applications, 2014.

[11] X. Liang, M. Barua, L. Chen, R. Lu, X. Shen, X. Li, and H.Y. Luo, "Enabling Pervasive Healthcare Through Continuous Remote Health Monitoring," IEEE transaction on Wireless Communications, vol.19, no. 6, pp. 10–18, Dec. 2012.

[12] Arduino Hardware and Software, Jun 2015, <u>www.arduino.cc</u>.

[13] Get the latest Arduino and Processing Pulse Sensor software, Jun 2015, http://pulsesensor.com.

[14] National Semiconductor Corporation, LM35 datasheet, precision centigrade temperature sensors, Atmel data book, November 2000 update.

[15] LEE J., "Oracle vs. MySQL vs. SQL Server: A Comparison of Popular RDBMS.

[16] Robin Nixon, " Learning PHP, MySQL, JavaScript, CSS & HTML5", Third Edition, O'Reilly Media, June 2014.

[17] "SQL Serv Man Studio", http://www.boosla.com. Accessed December 15, 2015.

[18] Dr. Mahmood F. Mosleh and Duaa SH. Talib, "Hardware Implementation of Wireless Sensor Network Using Arduino and Zigbee Protocol", Engineering and Technology Journal, Vol 34, Part (A), No 5, p.p. 816-829, 2016.

[19] Husam Ali Abdulmohsin, "Design and Implementation a Server Receiving Data in Both Forms TCP and UDP Through the Same Port and its Impact on the Network Performance", ", Engineering and Technology Journal, Vol 34, Part (B), No 2, p.p. 317-327, 2016.