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Applications of Sensor Networks to Finding the Shortest Path by Using Dijkstra's Algorithm

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***Abstract*—** Over the past two decades, the emergence of numerous new communication technologies has been witnessed. Among these, networking, optics, infrared, bluetooth are some. Many researchers have been focusing on this matter recently because nowadays, these technologies are used in a lot of fields in some emergency cases, especially to enable the monitoring of physical and environmental parameters for a variety of applications such as those used at homes, in offices, clinics, factories, vehicles, global environment and fire stations. These applications could monitor security and safety in the future in many private and local sectors. This paper focuses on sensor network technology used in driving smaller devices that use less power with greater functionality. It includes low – power microcontrollers with networking communication and various digital and analog sensors, a battery operated network of sensor modules to acquire a wide range of data and the real – time operating system to address the priorities of such a sensor network using low power, hard real – time constraints, and robust communication. This paper is the first step to monitoring fire and keeping it under control in conventional buildings and factories, and considers feasibility and reliability of sensor networks.

Keywords- *sensor networks, the shortest path, ATML 89c51, Dijkstra's Algorithm.*

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I. INTRODUCTION

Every environment has different kinds of sensors are in use, and these sensors are used in various fields such as buildings automation to controlling the lights, access allowance control, and refrigeration control, besides that, some other sensors used to measurement such as temperature, pressure, level sensing and machinery monitoring. Also, in power, there are sensors implemented as meters or for power distribution diagnostics. Nowadays, there are several different wire-based or actuators network products can be found in various fields. The wired sensors are expensive to install, inflexible once installed, limited in size, in complexity, and in functionality compared with wireless sensor networks are not restricted by these limitations.

The paper considered the fire as major concern to those who work in underground coal mines. It is focused on important issue which has a warning system that is capable of detecting fire and generating an alarm. Besides that, and it is explanation of the uses of Wireless Sensor Networks (WSN) to detect the specified fire location and also providing the fire prevention system to stop the spread of fire to save the natural resources and the mining personnel from fire [2].

II. FOUNDEMENTALS OF SENSOR NETWORKS

1. Data Communication

Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable. For data communications to occur, the communicating devices must be part of a communication system made up of a combination of hardware (physical equipment) and software (programs). The effectiveness of a data communications system depends on four fundamental characteristics: delivery, accuracy, timeliness, and jitter [4].

*A. Delivery*The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user [4].

B. Accuracy

The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable [4].

C. Timeliness

The system must deliver data in a timely manner. Data delivered late are useless. In the case of video and audio, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. This kind of delivery is called real-time transmission [4].

D. Jitter

Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets. For example, let us assume that video packets are sent every 3D-ms. If some of the packets arrive with 3D-ms delay and others with 4D-ms delay, an uneven quality in the video is the result [4].

2. Networks

A network is a number of clients connected with one server work with some protocols and it has set of devices and sometimes considered as nodes, and these nodes connected to each other by communication links. A node can be any device such as computer, printer, or any other device has ability to send and receive data via network communication[4].

3. Distributed Processing

Distributed processing is a task among multi network devices, besides that, there is one machine tasks of process, and handling computers separation [4].

4. Components of Data Communication System
A data communications system has five components explained in Fig.1 .

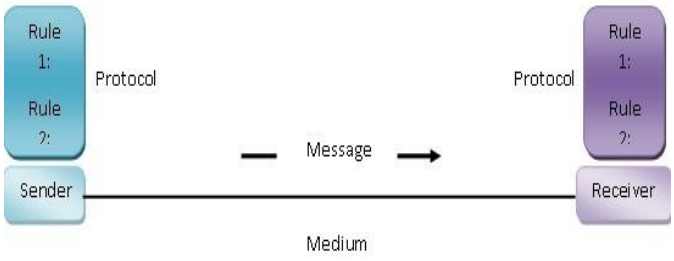

Figure 1. Data Communication System

III. CRITERIA OF SENSORS NETWORK

In sensors network communication there are criteria should be takes in consideration such as (performance, reliability, and security), and will discuss each of these criteria [4].

1. Performance

These criteria can be measured by transit and response time. The transit time means the amount of time which required when a message start is send from a device to another. The response time is the elapsed time between an inquiry and a response. In addition to that, the performance of a network could be based on a number of factors, instead number of users, transmission medium, the capabilities of the connected hardware, and the efficiency of the software [4].

2. Reliability

Other criteria is reliability of network and it one of important criteria of network which measure the failures of frequency and how much time the link takes to recover from a failure [4].

3. Security

The network security includes protecting data from unauthorized access to protecting data from damage and development and implementing policies and procedures for recovery from breaches and data losses and when application the security roles of designer for all fields software and hardware systems in the data set used it we found the perfect result in this fields we take it more of Security in software application and full Security for hardware components such as the Micro Controller and Security in D.B design and Security between connection client and server [4].

4. Sensor Network

Sensor networks represent a technology which execute a complex issues many inexpensive electromechanical micro-devices. These sensors could be attached in computational devices and/or embedded devices. In addition to that, these sensors used to be monitor changes in the operational environment. The sensor network devices could be found in battlefield, these devices may self-organize to act as numerous eyes and ears of soldiers surveying the field from a safe distance. Recently, the sensors found in embedded in unmanned air vehicles, they may monitor bio/chemical plumes in the atmosphere or handle hazardous materials on the ground. Also, the sensor network has been used as a mobile robots with embedded sensor systems which used as explorer the surface of planets; and found in systems of undersea robots are being designed to hunt for mines in shallow water and to develop high fidelity now casts and forecasts of the ocean through time–space coordinated sampling and in Fig.2. Explain the system of work between the server and client and included the type of connection between computers in the client side or the server side all of system control by the software applications with the same protocols.

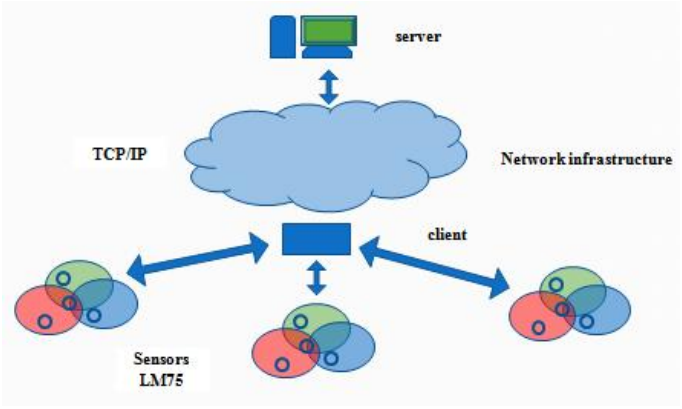

Figure 2. Sensor Networks Representation

5.Sensors

Typically a sensor is composed of components that sense the environment, process the data, and communicate with other sensors/computers and control the output result by server and save all the data in data base designed by access 2003. A

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sensor responds to a physical stimulus, such as heat, light, sound, or pressure, and produces a measurable electrical signal. Thus a sensor with its own sensing device, a memory, and a processor can typically be programmed with a high-level programming language in recent years it was observed taking most of the focus on an important aspect in the maintenance of electronic devices and systems as especially sensitive and preserve appropriate temperature and have control of the high and low temperatures develop sensors and an example as we used the LM75 sensor who has the ability to feel the high and low temperature as a very high level and can work with used control it in 8 Data bus in the same bus used. The sensing devices can range from nano-sensors to micro- and mega-sensors and all of them sensors work in the same speed when connected with controller devices in the baud rate is 9600 bps. And could refer to the sensor system such as a mote, which may have more than one physical sensor, its memory, processor, and other associated circuitry. Fig.3 shows distributed sensor architecture and various components [6].

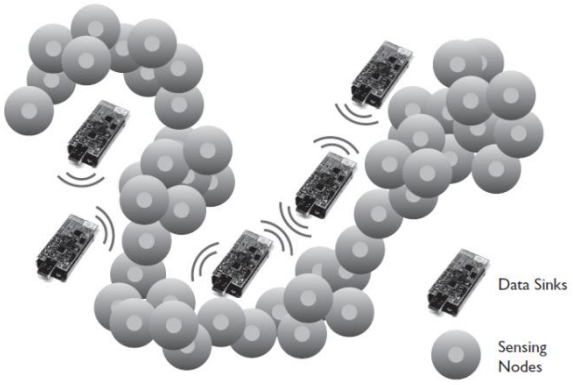

Figure 3.Networking Structure of a Distributed Sensor Network

6. System of Sensor Networks Communication

IN the Fig.4 explains how the system works in the (software and hardware) side for all of them the server PC and client PC.

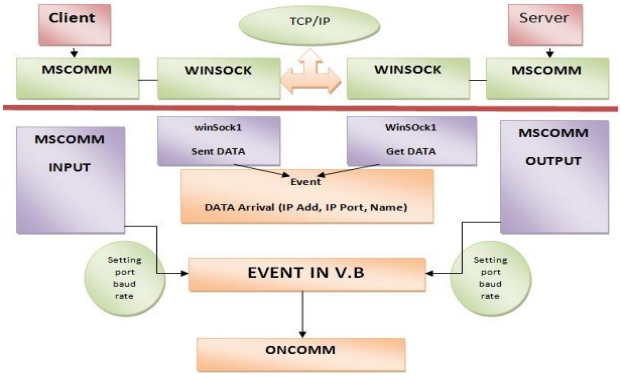

Figure 4. System of Sensor Networks

IV. DIJSTRA'S ALGORITHM

When used this algorithm in the server side after applying that in Visual Basic program to take the best path as Shortest Path between the server and client.The purpose of system is to collect and store environmental data for later processing by the server and send these data to client for monitoring. This is a mix of both PC and embedded system software as well as embedded system hardware.This system proposed contains both software and hardware design. It relied on networking infrastructure to provide communications between the Client and Server components. Besides that, the design application analysis the shortest path among nodes based on Dijkstra's algorithm. The focus of this system was to selectively present the collected environmental data to the end user in a graphical manner by using Visual Basic 6.0.

1. Block Diagram Description

There are four major phases implemented in our system, as shown in Fig.5.

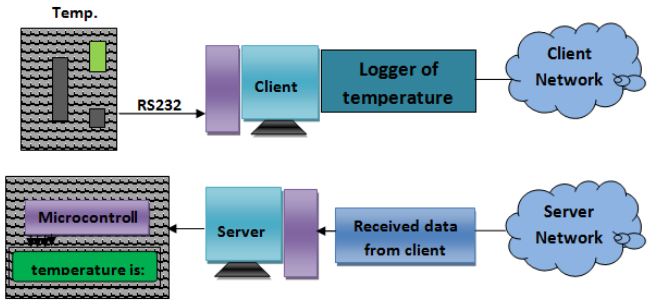

Figure 5. Main Block Diagram

2. Client Side System

The Client side system contents of component which are necessary external to the development. That is, any computer with a network could be a Client has been served only as a user interface to the data system. The system consist application and hardware. The application has been designed using Visual Basic 6.0 to control the socket of network using TCP/IP method and control the interface circuit design via serial port shown in Fig.6.

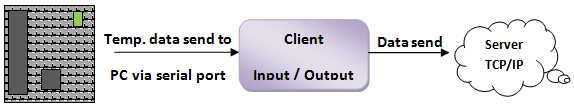

Figure 6. Client Main Component

In client side initialization process of communication be taken, whereas the server responds to incoming client requests. The protocol used is TCP/IP that can be used for the communication link. When a client connects to

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listening sockets the server receives a notification from Winsock accepts the connection and begins to dispatch and intercept messages to and from the new client.

3. *Server Side System*

The server side system has been designed to monitor the events of temperature on client(s) side. This system consists of application and hardware design. The application has two main processes, first control the socket of network and other process is a control the interface circuit design. When application request came in, the network server executes the application, which retrieved data from the database, processes it, and returns a data that the server transmitted to the Client as shown in Fig.7.

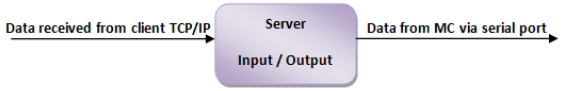

Figure 7. Server Main Component

V. EXPERIMENTS AND RESULTS

1. *Electronic Circuit Description in Client Side*

As discussed in this paper, there are two electronic circuits in both client and server system. The Fig.8. Shown the circuit schematic of client.

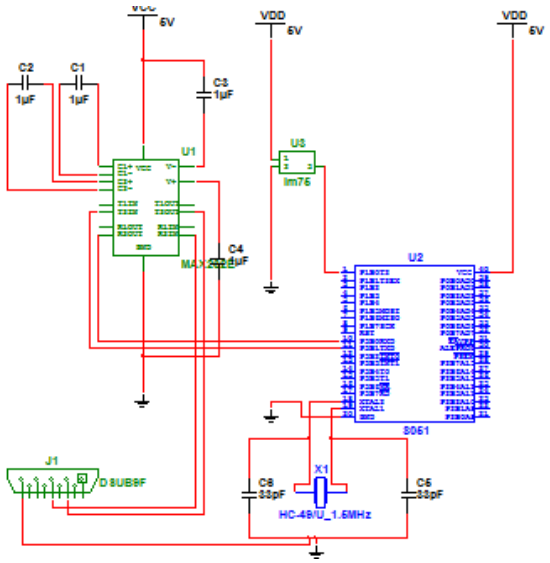

Figure 8. Schematic Circuit in Client Side.

The 2-wire communications protocol used to communicate serially with various types of devices similarly configured. The LM75, designed as a 'slave' device, can be configured through the I2C interface to alert, through various methods, the PC system that an over temperature condition has happened.To control the LM75, first, need to read which address to set and let the value to and from. Second, write the value of address to memory to be read, finally start reading the value from memory.The value will be a temperature, and this value will be ready to send from a microcontroller to serial port through TTL/Serial converter (MAX232). In same time, the program whom control the data on COM port (Visual Basic), will received the data, and display it on TEXTBOX as shown in Fig.9.Finally the data will be send to server side via network using TCP/IP socket.

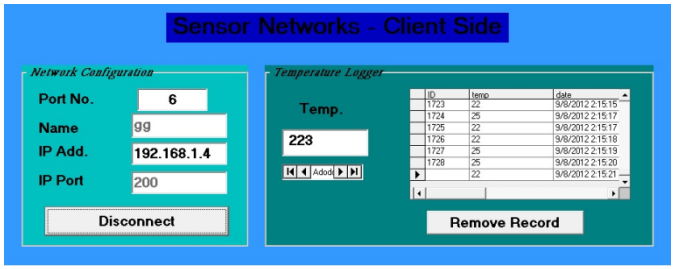

Figure 9. Interface Application Design in Client Side

In server side, the design of electronic circuit has been modeled to received the data from client via TCP/IP socket, the application received the data that determined the temperature and forward this data to electronic circuit that interfaced to server PC as shown in Fig 10.

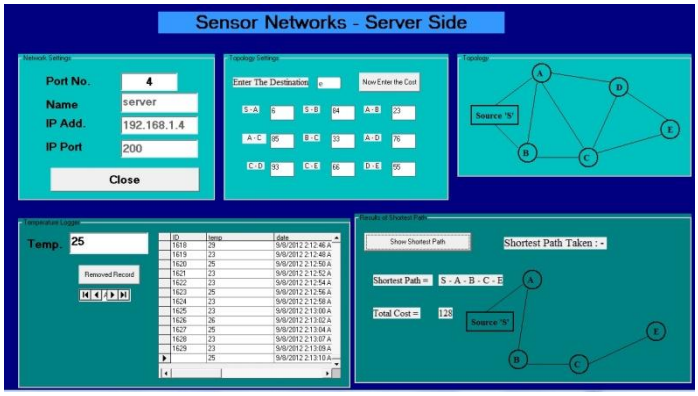

Figure 10. The User Interface of the Server Side Application

The microcontroller will received the data from PC, and send it directly to LCD to be displayed as shown in schematic design in Fig 11.

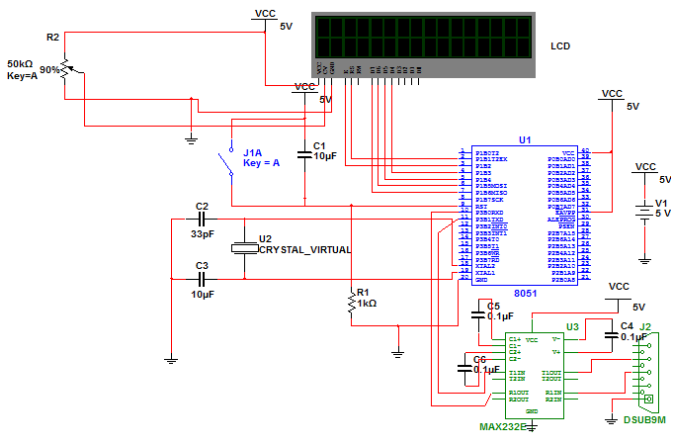

Figure 11. Schematic Design of Server Side

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2. *The LM75 in Pin Connection of I2C*

We've purposed and present the design system of a wireless sensor network for monitoring the temperature status. The sensor network consists of client and server nodes for temperature sensing. These nodes communicate by used a TCP/IP network.The temperature sensor (LM75) is connected to the ATML 89c51 microcontroller on input pins numbered 0.1 and 0.2 as shown in Fig12.The electronic circuit interfaced to client PC start reads temperature through temperature sensor. The LM75 registers are accessible through the I2C port

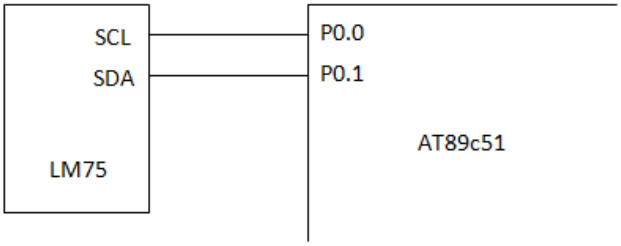

Figure 12. Pin Connection of I2C

3. *Temperature Sensor Measurements*

Table 1.Temperature Sensor Measurements on Various Environments

Environment	Normal Temp.	Time
Room	37	9:00
Room	38	9:30
Room	38.5	10:00
Office	36	9:00
Office	36.5	11:00
Office	37.5	02:00
Factory	38	10:00
Factory	38.5	11:00

Fig.13. Shows curves belong to the table above which shows temperature for each environment changed on time.

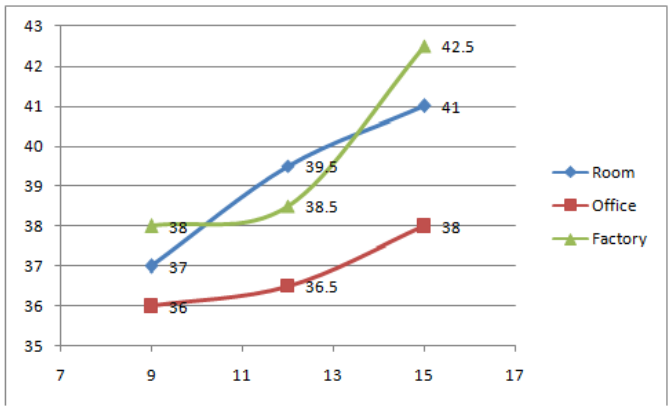

Figure13. Temperature Changes Over Time in Various Environments

We performed a test for temperature monitoring between 9am to 1pm. The system collected the temperature readings at specific sensor and got the temperature value, in addition to that, the value(s) of temperature directly saved in database file (.MDB), the database has been designed using Microsoft Access 2007, which contains two fields (temperature and date/time).

In application design, we've connect to the database using ADODC component and the provider of database connection was OLE JET 4.0. Finally, the data has been showed up in the form design using DATAGRID component and this one bring up the data via ADODC.Another case study has been simulated in this paper which focuses on issue how to find shortest path between source and destination node. For the same topology design we've specified the length and connection among nodes as describe in Table2.

Table 2. Connections and lengths of The Designed Topology

Link	Length
(A, source)	10
(B,Source)	20
(Source, A)	10
(B,A)	15
(C,A)	10
(D,A)	4
(Source,B)	20
(A,B)	15
(C,B)	2
(A,C)	12
(B,C)	2
(D,C)	10
(E,C)	10
(A,D)	4
(C,D)	10
(E,D)	12
(C,E)	10
(D,E)	12

And all paths in the topology are shown Table 3.

Table 3. All Connections of The Designed Topology

	Source	A	B	C	D	E
Source	0	10	20	22	14	26
A	10	0	14	12	4	16
B	20	12	0	2	12	12
C	20	10	2	0	10	10
D	14	4	12	10	0	12
E	26	16	12	10	12	0

The purposed algorithm to find shortest path in this research is called Dijkstra's algorithm. When try to find the shortest path

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from Source to destination node (E).

IN this paper we found the following Total length is 26, and the shortest path is: (Source→ A→ D → E), and the path has been drawn as shown in Fig.14.

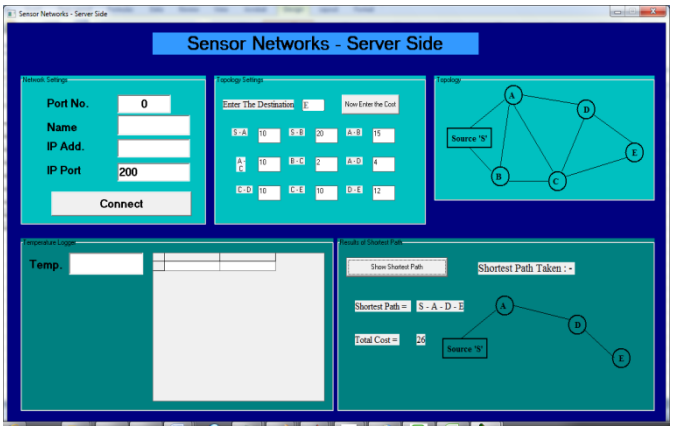

Figure 14. Shortest Path Drawn from Source to Node (E)

IV. CONCLUSION

In modern fire stations, several measurement points are taken in different parts of the station to make the fire station system work properly. Networking would make the measurement system easier. Furthermore, the system proposed is controlling one or several sensors are an attractive and cost efficient option to build the required measurement system. In this paper, we developed a network sensor node for fire station monitoring by integrating a sensor with commercial sensors capable to measure temperature values. The system proposed was tested by deploying a simple sensor network into Fire station in Baghdad. We collected data to evaluate the network reliability and its ability to detect the fire and temperature, which typically exist in the client. We were also able to monitoring the sensors situations and show that the network can detect the differences temperatures caused by various disturbances, such as direct heat near the sensor or heat halted in sensor(s).In sensor network, it's an important to monitor the events on other nodes (clients), and one of these events, it's the temperature which considered as an critical issue especially on manufacturing, production line, secured places, and other places and sectors.

REFERENCES

[1] Jorge Chang, Amarnath Kolla, and Somya Kapoor; "Security Threats in Wireless Sensor Network"; 2006.
[2] “Fire monitoring in coal mines using Wireless Sensor Networks; Roy, P.; Bhattacharjee, S.; Ghosh, S.; Misra, S.; Obaidat, M.S 2011”.
[3] Jan Axelson; "Serial Port Complete: Programming and Circuits for Rs-232"; lakeview research; 1998.
[4] Behrouz A. Forouzan; "Data Communication and Networking"; McGraw-Hill, Forouzan Networking Series; 4th Edition, 2007.
[5] Shashi Phoha, Thomas LaPorta, Christopher Griffin; "Sensor Network Operations"; IEEE Press; 2006.
[6] S. Sitharaa Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye; "Fundamentals of Sensor Network Programming, Applications and Technology"; IEEE Press-Wiley; 2011.
[7] Brian Siler and Jeff Spotts; "Using Visual Basic 6.0, Special Edition"; Que publishing; 1998.
[8] Thomas H. Cormen, Charles E. Leiserson, Ronld L. Rivest, Clifford Stein; "Introduction to Algorithms"; 3rd ed; MIT Press; 2009.