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Development of a New Software to Transmit the Audio Signals without Server-Based

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Abstract – In this study, it has been planned to communicate directly on mobile without connecting a server in a public or wide area with a radio between two computers and then, some software has been designed. For this, in Visual Studio 2010 C# platform, it has been produced two different software which work simultaneously in transmitter / receiver computers. Text data typed in transmitting computer for communication has been transformed into audio signal via the Ses_Uret software which has been improved for this study, then these data transformed into audio signals have been transferred to another electronic environment through the radio. In this communication period, the loudspeaker and microphone of the transmitting / receiving computers have been used as a detector and convertor. Audio signals which have reached to receiving computer have transformed into the meaningful text via the Ses_Yakala software and mobile communication took place. Bringing this software into use in a fixed or mobile position would be beneficial in some urgent situations when the communication system doesn't work and the radios work.
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Keywords *-*
Mobile Communication, Audio and Signals, Radio, Visual Studio 2010 C#.

1. Introduction

Communication has always been important in human life. So, improvement of technology and electronic media and communication made with electronic devices give a global meaning to the communication, and this makes the communication in electronic media indispensable part of human life [1].

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As a result of increasing the number of the high-tech computer used in daily and work life, the necessity of communication between computers to make the tasks easy and quick has occurred [2]. So, network topology has been improved, and it has been used in work and social life. Network established with fiber wires and ethernet between computers has started to give its place to wireless-mobile communication technology because of such reasons as increasing the usage of mobile network, cooperation in devices connected to network, desire to reach the information without waiting, expanding the network easier and improved guest access [3]. In this content, Hui Guo et al. have designed a PLC and computer based wireless communication system by using a wireless receiver-transmitter module [4]. While Al Shahriar et al. [5] have brought about the communication between two computers which have 8 meters between them by using Matlab program, Özütürk has provided computers to communicate with each other with infared (IR) [6].

On the other side, it has been observed that different applications have been designed and practiced on mobile devices. Accident determination with mobile phones [7], health [8] and education [9,10] applications on smart phones has revealed the great contribution on this segment. Subaşı [11], has improved a database application.

About radios, Şahin [12] has informed about the radio communication that can be used by the units who give service in the field of social work and public security that is appropriate for the international standards. Kalaç [13] has examined the wire-wireless telecommunication system in terms of Turkey. Ovalı and his friends made communication between two computers by creating a radio modem with wireless RS232 [14]. Dirik [15], on his work which named "online remote tracking system" has follow up the devices' location and speed parameters from far away with the help of the radios. Şut and his friends [16], have designed an application for 112 immediate aid. Workers of 112 has reached to scene of accidents with the help of the radio communication, and this application has been practiced in Antalya and Isparta. Saraç [17], has determined the location and fingerprint of the radio data with his study "Location and Identification of Radio Transmitter System Design".

In this study, it has been aimed to send the texts which people write in an electronic environment to another electronic device via the radios, therefore it has been aimed to communicate between two computers without connecting a network or Internet. It has been improved an application by explaining the radios and mobile communication devices used in the study, and it has been discussed the usability of this software in the light of these findings and examinations. When the studies done in literature have been examined, it has been seen a wide area study that enables business and workers free messaging.

2. Mobile Communication and Elements

Communication is the transfer of information and exchange [18]. Electronic communication is transferring information by using artificial equipment on some special distances [19]. It is aimed to transmission of data to the receiver without missing any information. Information memorandum that would be transmitted is transmitted to remote distance by transforming into electromagnetic energy, and it is transformed into information cluster [20].

Electronic communication is categorized according to media type, wire-wireless or signal type, analog-digital [21,22]. Information transmission in wireless communication is realized on space with electromagnetic waves. In Figure 1, it is illustrated the elements of mobile communication.

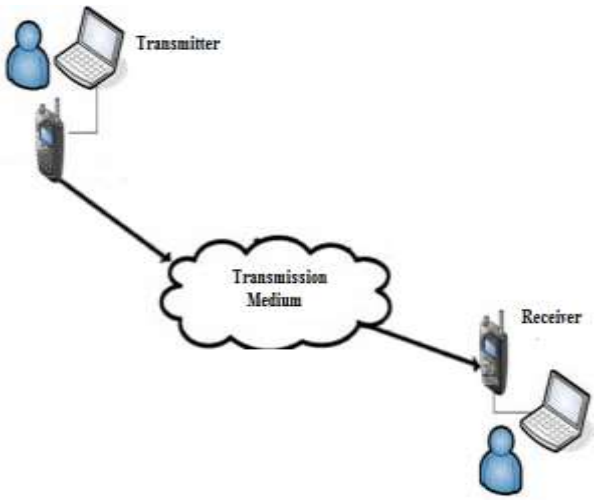

Figure 1. Elements of mobile communication

Transmitter seen in Figure 1 composes of information memorandum that would be sent and essential coding, transmission medium composes of coded information memorandum, and receiver composes of physical and virtual media (network topology) which tries to transform the signals into meaningful content.

In wireless communication, mobile communication devices such as smartphone, radio and tablet are used. These devices allow data communication with Bluetooth, ZigBee, NFC, Wi-Fi, (IEEE 802.11a/B), UMTS, GPRS, EDGE, CDMA, HSCSD, WIMAX (IEEE 802.16e) technology [23]. Beside this, multi-access technical, digital modulation technical and audio coding technical are used [13].

In this study, radio technology used as a mobile communication area has been used for communication in public and private area. Audio, image and this kind of information has been sent from one point to another with the help of the electromagnetic waves.
To communicate with radio, at least two devices which work at the same frequency and has the same technical features are needed. Communication occurs like this: First, electromagnetic waves which spread into the space with the help of the wires and radio get out from the transmitting device, then these waves reach to receiver device through the aerial and the wire of the receiver device.

Radio equipment consists of radio itself, feeding unit, aerial, aerial wire and microphone. In Figure 2, it is illustrated the items that consist of radio.

Figure 2. Constituent parts of the radio

Radios are classified as their usage, land, air and sea; as devices, hand, device and fixed radio. Besides, they are classified as their operating frequency, HF (High Frequency), VHF (Very High Frequency), UHF (Ultra High Frequency). While UHF is used for long-distance communication, VHF is appropriate for medium and short-distance communication. UHF makes more efficient communication despite of having shorter range of influence. [24] One important issue in radio system is the field of tractive force. Tractive force may change depending upon the equipment used, height of the aerial and weather conditions.

One important point about the radio communication is that radios work differently in different modes such as duplex, half duplex and simplex during receiving and transmitting. [25] When the radios work with the same frequency during receiving and transmitting, it is named as simplex work. However, they work with different frequency, it is named as duplex work.

In this study, UHF Simplex two hand radios (Baofeng UV-5R) have been used. These radios have 1W /5W output power. Radios and computers improve a software and this has been applied to Muğla Metropolitan Municipality Private Public Bus so, communication has been made with no problems.

3. Developed Application

In this study, two notebooks, two radios and a mobile software that make communication through the radio have been improved. This software has been used in a mobile communication area. This study has been applied with a program prepared in Visual Studio 2010 C# platform, and codes have been produced. Ses_Uret transforms a text produced for communication into audio signals, and these signals are conveyed to another computer through radios, and then Ses_Yakala transforms these signals into meaningful text. Ses_Yakala has been prepared by the help of "Sound Activated Recorder with Spectrogram in C#" program [26]. Therefore, messages reached from transmitter computer to the

receiver computer and messages' arrival time have been examined and interpreted. In Figure 3, it is illustrated how system works.

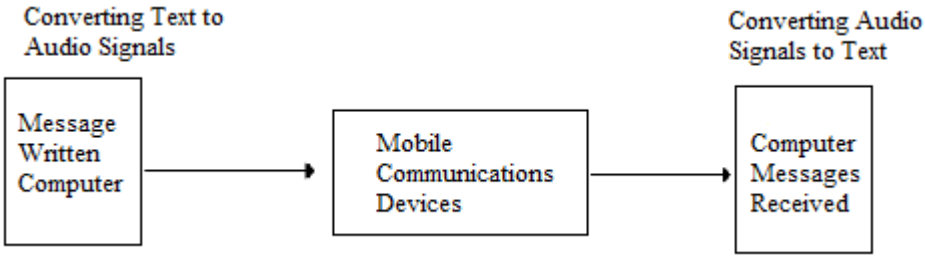

Figure 3. The block diagram of the application

Working stage of this communication system is like that:

- Input of the loudspeaker of the transmitting computer connects to the input of the microphone of the transmitting radio with the help of the audio connection wire. Likewise, output of the loudspeaker of receiving radio connects to the input of the microphone of receiving computer.
- Two radios are adjusted to the same frequency.
- Ses_Uret (Figure 4) in transmitting computer and Ses_Yakala (Figure 5) software are adjusted to the same value simultaneously.
- Ses_Uret program is activated. Audio signals are produced. Signals transmit to the transmitting radio via audio connection wire and transmission of the audio signals are made.
- Audio signals reached from transmitting radio to receiving radio come to receiving computer with the help of the audio connection wires.

Meanwhile, Ses_Yakala software transforms the audio signals into meaningful text. Therefore, communication (messaging) between two computers occurs.

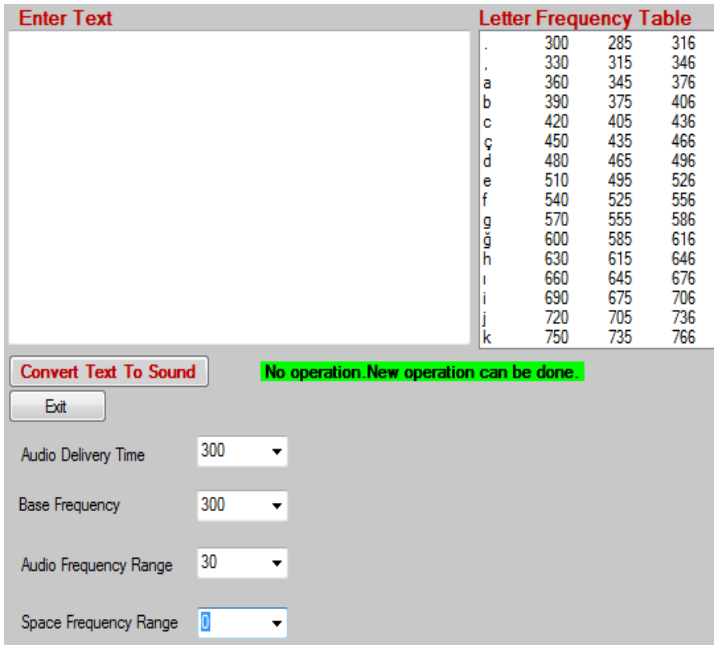

Figure 4. Ses_Uret interface

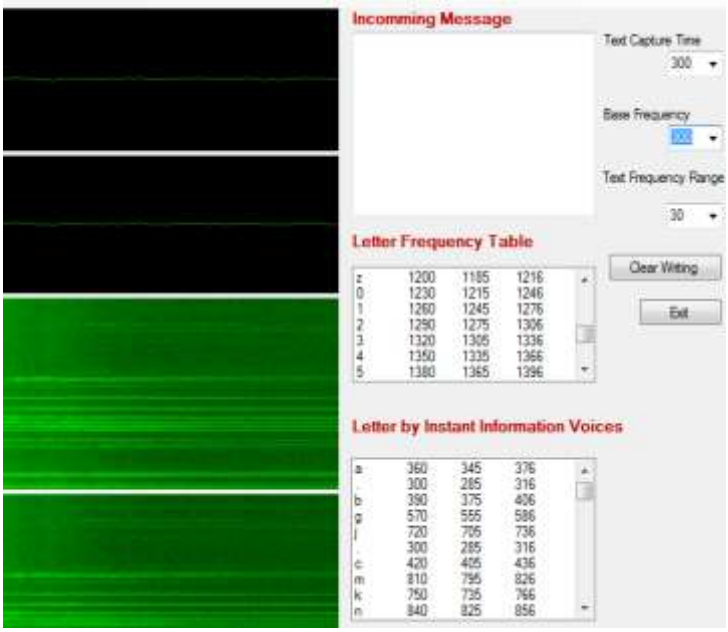

Figure 5. Ses_Yakala interface

Introducing characters to the computer as an audio signals in both software is an important stage. It is realized with the help of 'Base Frequency' value illustrated in figure 4 and 5. This value based on giving each characters on keyboard a frequency range. Process is done by matching each character with a frequency. So, in transmitting computer, transforming character into audio signal and in receiving computer, transforming audio signals into characters are important. To make identification of characters in both interface application, some part of the codes is given below.

```
int amplitude = 32760;// -(karakterNo * 7500);  // 32760; Max amplitude for 16-bit audio
                double freq = 440.0f; //+(karakterNo * 100.0f);   // Concert A: 440Hz
                double freq5 = 220.0f;
                double freq2 = 440.0f;
                double freq3 = 392.0f;
                double freq4 = 550.0f;
                double freq1 = 3900.0f;
                double freq6 = 700.0f;
if (harf == "a")
        {
           frek = 150;
        }
        else if (harf == "b")
        {
           frek = 180;
        }
        else if (harf == "c")
        {
           frek = 210;
        }
        else if (harf == "ç")
        {
           frek = 240;
        }
```

Besides, in applications, duration of sending messages and base frequency range used while transforming each letter into audio signal are paid attention. Because conveying data accurately and complete is important.

Designed software system has been used in Aydın-Efeler and Muğla-Menteşe for communication tests. Route information of the study carried out in Efeler province is illustrated in Figure 6, and route information of the study carried out in Menteşe province is illustrated in Figure 7. While in Efeler, first communication unit is in (transmitter) Ulukent, in second communication unit (receiver) is in Murat-Hale Küçükoğlu VTAHS. While in test work here, transmitting unit is in the fixed position, receiving unit is in both fixed and mobile position. UHF frequency band range has been used to communicate with radios. The reason of this is that tractive force and coverage zone of frequency band range of UHF is higher than that of VHF. Beside this, in bad weather condition and in high building UHF works better.

In test work carried out in Muğla-Menteşe, while transmitting unit is fixed, receiving unit in motion from starting point of Muğla Private Public Bus through Gazi Anatolian High School route. For the communication media, Muğla Metropolitan Municipality Private Public Bus radio frequency band range which is in VHF band range is used.

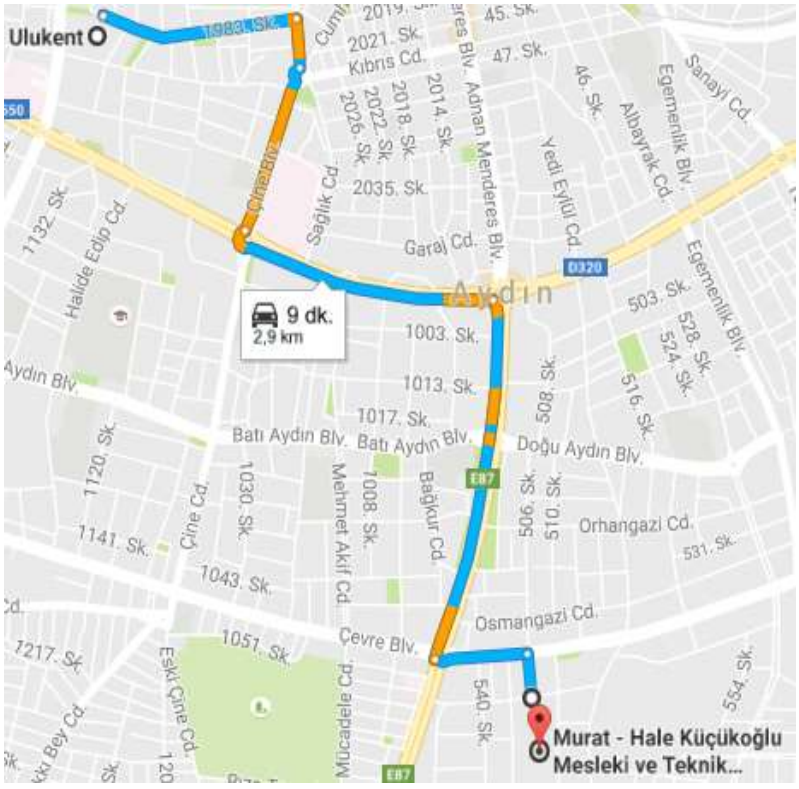

Figure 6. Ulukent-Murat-Hale Küçükoğlu VTAHS route (Aydın)

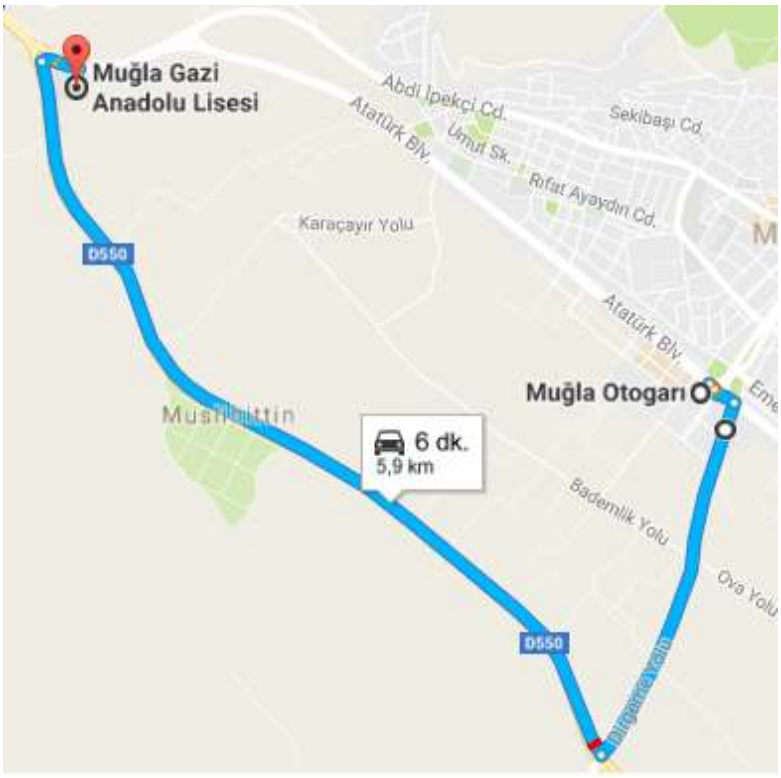

Figure 7. Bus Terminal-Gazi Anatolian High School route (Muğla)

Route illustrated in Figure 6 is in the city center and the distance between transmitting-receiving unit is 3 km. Most of the areas of the route in Figure 7 are level areas and it is 6 km far from the city center. In the test work, the same radios have been used in both city. Software has been worked through the route. 'Sent and received' message data obtained after software worked, has been saved in an Excel file with parameter value which is in both software. Success rate of communication test carried out with the help of communication data (Table 1-3) has been created. (Figure 8 a, b, c)

Base frequency range and time values are shown in Table 1 below.
Data obtained from Efeler-Aydın;
Text sent: ***09 ab 1234 sabit***
Radio Frequency: ***UHF Frekansı***
Position: ***Fixed***

Table 1. Condition of receiving-sending messages while transmitting and receiving computers are in the fixed position (Efeler / Aydın)

Time (ms)	Base Frequency (Hertz)	Received Text
100	200	
100	250	9
100	300	9b
200	250	09 12
200	300	09 234
200	400	09 a 23e
200	450	09 a14

Table 1.(*continuation)*

Time (ms)	Base Frequency (Hertz)	Received Text
200	500	09 3hzr
300	250	09 124 ı
300	300	k09 1234 sat
300	400	l09 a 1234 sbt
300	450	m09 b 1234 sbtt
300	500	09 ab 1234 sabt
400	250	09 b1234 sabt
400	300	09 ub 1234 ebit
400	400	09 ab 1234 sabi
400	450	09 ab 1234 sabit
400	500	09 ab 1234 sabit
500	250	09 ab 1234 st
500	300	09 ab 1234 sbit
500	400	09 ab 124 saabit
500	450	09 ab 1234 sait
500	500	09 ab 1234 sabit
600	250	09 b 1234 saib
600	300	09 ab 1234 stib
600	400	09 ab 1234 saabt
600	450	09 ab 1234 sabi
600	500	09 ab 1234 sabit
700	300	09 ab 1234 sbit
700	400	09 ab 1234 saait
700	450	09 ab 1234 sabi
700	500	09 ab 1234 sabit
800	300	09 ab 1234 ssbit
800	350	9 ab 1234 sab
800	400	09 ab 1234 sabt
900	450	09 ab 13 sabt

When Table 1 is examined, it can be seen that the most successful base frequency value is 500hz. For being conveyed the audio signals from transmitting to receiving, at least 200ms is needed to pass. Meanwhile, above 500ms, it has been observed that the success rate of communication hasn't change, even some errors have been observed while receiving and sending messages.

In communication, transmitting and receiving unit hasn't always been in fixed position. Sometimes, one or both of these units can be in motion. For this reason, in second test in Aydın, the study carried out when transmitting unit is fixed, receiving unit is in motion. Route is shown in Figure 6. Receiving unit has been kept in car. To enhance the tractive force of the receiving unit's radio, radio has been connected with the device aerial and car has been kept in motion. According to this, some part of the base frequency range and time value is illustrated in Table 2.

Data obtained from Efeler-Aydın;
Text sent: ***09 ab hareketli***

Radio Frequency: ***UHF***
Position: ***In motion from Ulukent to Murat-Hale Küçükoğlu VTAHS***

Table 2. Condition of receiving-sending messages while the transmitting unit is fixed and receiving unit is in motion. (Efeler / Aydın)

Time (ms)	Base Frequency (Hertz)	Received Text
200	300	09 ab hurekel
300	300	09ab hureketli
300	400	09 ab hnreketli
300	500	09 ab hareketli
300	600	d09 aahareketlj
300	600	d09 ab hareketlj
400	300	09 ab hureketli
400	400	09 ab hareketli
400	500	09 ab hareketli
400	600	09 b heketli
400	600	09 ab hareketli
500	200	09 b hreki
500	250	09a harktrli
500	300	09 ab hrktli
500	350	09 ab harekitli
500	400	09 ab hareketli
500	500	09 ab hareketli
500	600	09 ab areketi
500	600	09 ab hareketli
600	400	09 ab hareketli

When Table 2 is examined, the messaging is successful when the base frequency is 300, 400 and 500hz and the time is 300, 400 and 500ms. According to previous test study, it has become successful in shorter time and in less base frequency value (such as 300ms, 300hz). The reasons why it has become more successful in shorter time and in less base frequency value are having an open view of the receiving unit in route and having been a clear sight between receiving-transmitting unit, and finally enhancing tractive force of the radio thanks to be used a device aerial.

Another study has been done in Menteşe-Muğla. While carried out this study, communication test study has been made to obtain the best base frequency value (such as 400, 500hz) from Aydın-Efeler. While the transmitting unit is in which Muğla Private Public Buses starting point, receiving unit is in which a bus moving from this point to Gazi Anatolian High School route. Frequency rate and time value obtained from test study are illustrated in Table 3.

Data obtained in Muğla city;
Text sent: ***48 hareketli 42***
Radio Frequency: ***Muğla Private Public Buses Radio Frequency***
Position: ***In motion from the Starting Point of Buses to Gazi Anatolian High School***

Table 3. The situation of receiving-sending message while transmitting unit is fixed, receiving unit is in motion (Menteşe -Muğla)

Time (ms)	Base Frequency (Hertz)	Received Text
300	400	hark
300	500	li
350	400	treti 42
400	400	4 harektia3
400	500	48 hl
500	400	48 hakl42
500	400	48 hareket
500	500	48 hareee
600	500	48 hareketli 42
600	600	48 hareketli 42
700	400	48 eketli 42
700	400	harktli 4
700	500	48 hareketli 42
700	500	harketli 48
700	600	48 hareketli 42
800	400	48 hareketli 42
800	500	8 hareketli 2
800	600	48 hareketli 42

When Table 3 is examined, it can be seen that the best success rate of base frequency value is 400hz, and time is 800ms. In other values, it has been observed that some errors occurred while messaging. It has been observed that when the time value decreases, received messages have some errors. The reason is that receiving unit moves away from the transmitting unit, and the distance between them increases. Another reason is that weakening the tractive force of the radio. If another device wasn't use to enhance the tractive force, message wouldn't reach completely and right. Beside, under the effect of being in motion, noise level of the radio which is high from 65 dB make noise for radio and effects the audio signals. These audio signals in outdoor and audio signals produced by software can be confused, and this prevent messages not to convey completely. Success rate of the test study is illustrated in Figure 8 into three pieces.

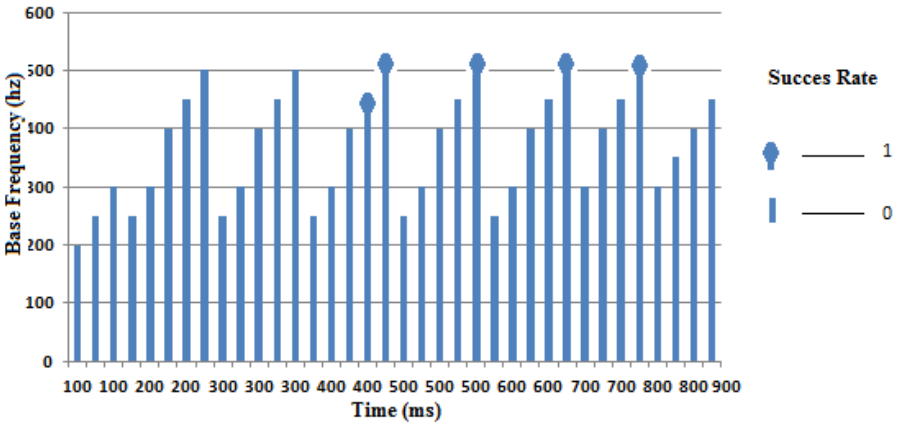

Figure 8. Communication success rate while transmitter and receiver in fixed position (a) (Efeler-Aydın)

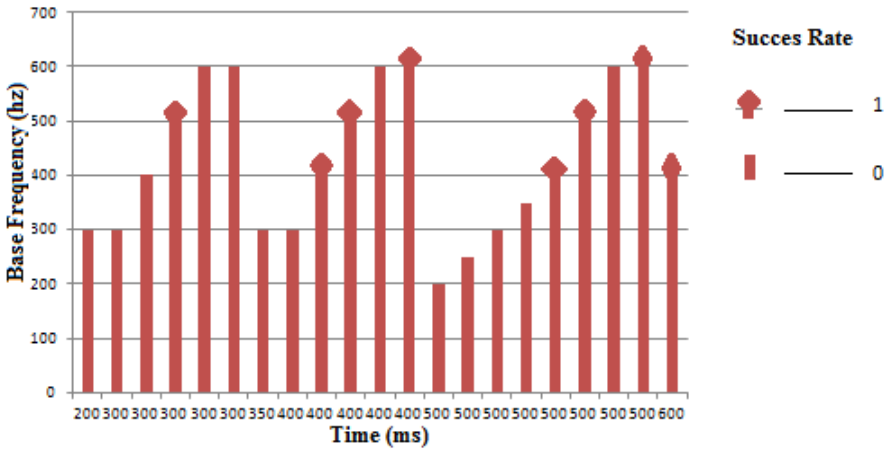

Figure 8: (continuation) Communication success rate while transmitter is fixed and receiver is in motion (b) (Efeler-Aydın)

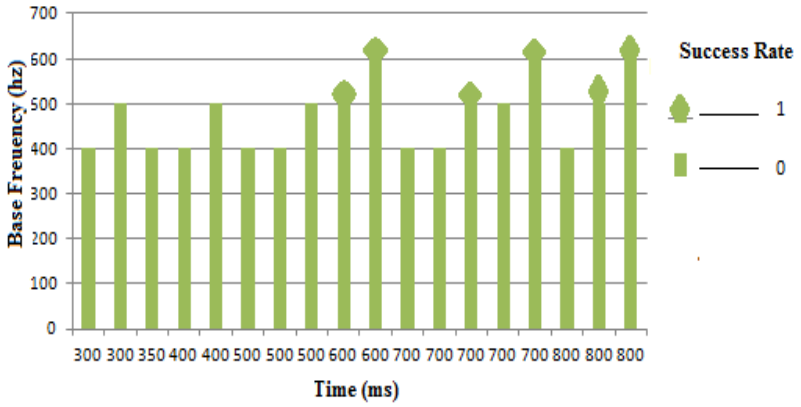

Figure 8. (continuation) Communication success rate while transmitter is fixed and receiver is in motion (c) (Menteşe-Muğla)

When Figure 8 is examined, if the success rate is 1 (one), it means message sent by transmitting unit reaches to the receiving unit completely. If the value is 0 (zero), it means received message data isn't same as the message sent by transmitting unit. According to graphics, if the base frequency values is 400-600hz and time is between the range of 300-500ms, the messaging occurs completely without any error. Above 500ms sending, radios have been affected from the parasites, and this prevent messages convey with error. At the same time, to make communication between transmitter and receiver, at least 200ms is needed to pass.

4. Conclusion and Suggestions

Two software has been designed to make communication via radios between two computers without connecting any network/Internet. These software has the quality to be

created if needed. Especially, this software would be beneficial when there is no communication system other than radios.

For the software design, MS Visual Studio C#.NET programming language has been used. Software has been worked in Aydın-Efeler and Muğla-Menteşe. 'Sent and received' message data obtained after software worked, have been analyzed and situation of success has been determined. According to data, success in communication when transmitting and receiving computer is in the fixed position, is 100%, however communication made in motion, success rate decreases and it has been observed some missing part in messages. At the same time, 'base frequency' and 'Time' values used in software have been successful only in high value (800ms). This means messages would be sent more slowly and would effect from the noise coming from outdoor. However, when device aerial which enhance the tractive force of the radio is used, it has been observed that there are no such problems, communication is made fast and success rate has reached to 100%. To prevent the missing part while messaging, it is necessary to enhance radio signals.

In test work, base frequency is 400-600hz, and time is 300-500ms. Under and above these values, communication cannot be made properly. These errors may result from the tractive force of the radio, height of the buildings, bad weather conditions, or the voice which is above 65db. Besides, to communicate at least 200ms time is needed. In time which is above 550ms, it hasn't been observed a positive change in receiving and sending message, but generally this prevents a healthy communication.

Test work carried out in Efeler-Aydın is more successful than the work carried out in Menteşe-Muğla. The reason is that distance between transmitter and receiver in Aydın-Efeler is shorter than that of Menteşe-Muğla. Another reason is that tractive force of the radio used in Efeler is sufficient, but in Menteşe it is not sufficient. Besides, not being used a device which helps enhance the signal has affected the success.

Messaging has made successfully where the tractive force is sufficient for radio. When the tractive force of the radio has weakened, audio signals sent by transmitting unit, hasn't reached completely to the receiver. For the long distances, radio signals should be strengthened.
In this study, to communicate between two computers via radio, two software have been improved. To practice these software in fixed position or in motion would be beneficial when there is no other communication devices except for radios. Besides, this study sets an example for the following study and software.

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