EE214 ELECTRONIC CIRCUITS LABORATORY
TERM PROJECT
WIRELESS FIRE DETECTION SYSTEM

1. DESIGN SPECIFICATIONS

1.1. SPECIFICATIONS FOR THE SENSING UNIT

The sensing unit consists of three temperature sensors and they should be at least 10cm apart from each other. There are many different temperature sensors that you can find and use in this project, however, LM35 is strongly suggested.

During the temperature measurement, soldering iron or heat gun will be used and great variation of temperature differences between the sensor measurements can be obtained by keeping them apart from the sensors with different distances.

1.2. SPECIFICATIONS FOR SINUSOIDAL SIGNAL GENERATION PART

In this part, you can use any method that you want and learn from EE214 course, **UNLESS** you do not use circuit components other than the allowed ones.

Also, you must generate two sine waves with two different frequencies and these frequency values are as follows:

f_1 = 3kHz

f_2 = 5kHz

There can only be ±5% variation in these frequency values and any violation of this rule will cost you points even if your project works well. The amount of the points that will be deducted will be announced later.

1.3. SPECIFICATIONS FOR WIRELESS TRANSMISSION

In order to utilize wireless transmission, you will use a speaker and an electret microphone. Speaker that you will use in this project must be 50 Ω, 75 Ω or 100 Ω depending on your choice and design. In addition to that, there should not be any integrated circuit that is integrated to the microphone or speaker and violation of this rule will be considered seriously. You should drive the speaker by your own design and you should make the microphone work by yourself. Finally, speaker and the microphone should be at least 10cm apart from each other.

1.4. SPECIFICATIONS FOR FILTER BANK

You should extract the temperature information from the signal received from the microphone. In order to do so, you should design filters. By designing your filters, you can differentiate two different sinusoidal signals. After differentiating each of them separately, you will check the amplitudes of them in

the decision unit. However, the filters that you will use **MUST** be bandpass filters in order to utilize high quality differentiation between two signals with two different frequencies. Any violation of this rule, i.e. utilization of lowpass, highpass or any other different filter type, will be considered seriously. Your filters will be considered as not working properly if you do not use bandpass filters.

1.5. Specifications For Decision Unit

In this final part of the project, you will consider the amplitudes of the signals that are extracted from the filter. Any choice of low-reference (logic 0 case) and high-reference (logic 1 case) voltages are welcome and also you can use different low- and high- reference voltages for different frequencies. After you sense and decide which temperature sensor senses the highest temperature, you will indicate that by LEDs. You should use three different colours for LEDs and the colour difference between different LEDs must be clear, i.e. one cannot differentiate so called ”lemon yellow” and “lemon green” as you may can. You can use RGB LEDs or standard LEDs in your design. Utilization of any integrated logic chips is forbidden.

2. BONUS

A student cannot get any bonus credit, unless all steps that are announced in the project document are accomplished. In other words, you must get full credit from the design test to be able to get bonus credit.

2.1. Utilization Of Longer Distances In Wireless Transmission

For this step, you should adjust your speaker driver circuits such that the wireless communication will be performed when the distance between the speaker and the microphone is longer than 10cm. The extra points that you will get will be as follows:

Table 1. Extra points for different distances between the speaker and the microphone.

Distance Between The Speaker and The Microphone	Extra Points
15cm	2
20cm	4
25cm	6
30cm	8

2.2. Detection Of Idle Case (20 Points)

In this project, as explained before, you will encode the information in 2-bits for three different cases. You will use 11, 10, 01 binary states in order to indicate which temperature sensor senses the highest temperature. However, we do not use 00 binary state since it can be effected by noise in the environment.

For this step, you should use the idle state (00 binary state) in order to indicate that the temperature for all three locations are below a certain threshold, i.e. the highest temperature does not indicate any sign of fire. For example, you may sense 26, 28, 32 ^{o}C from the sensors, however, these

temperature levels are not sufficient to warn someone about fire. In order to avoid any panic in the house in the middle of the night, you are required to decide a threshold level, below which none of the LEDs will shine. In other words, you will decide a temperature value and this will be the threshold. If the temperature obtained from the sensors are all below this value, you will lighten up another LED to indicate that everything is fine. If one or more of the temperatures are above the threshold, your circuit will work properly as before.

Table 2. Different cases with different temperature values sensed by the sensors.

Case	LED that should be lighten up
($T_1>T_2>T_3$ OR $T_1>T_3>T_2$) AND (at least $T_1>T_{threshold}$)	LED1(Colour1)
($T_2>T_1>T_3$ OR $T_2>T_3>T_1$) AND (at least $T_2>T_{threshold}$)	LED2(Colour2)
($T_3>T_2>T_1$ OR $T_3>T_1>T_2$) AND (at least $T_3>T_{threshold}$)	LED3(Colour3)
$T_1,T_2,T_3 < T_{threshold}$	LED4(Colour4)