MORSE CODE ENCODER

CSE2006- MICROPROCESSORS AND MICROCONTROLLERS

J COMPONENT PROJECT REPORT

Submitted by

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TABLE OF CONTENTS

ABSTRACT

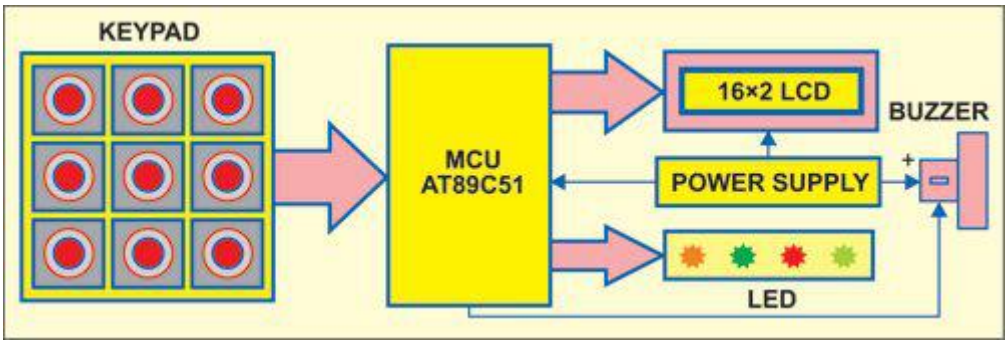
This project proposes the Morse code which is the earliest method used in Radio Telegraphy. Because of advanced telecommunication systems it is considered to be an outdated technique. Travelers, Sailors, Villagers from remote areas where cellular networks are almost inaccessible would need a most reliable mode of communication. But, then there are chances that they might not able to handle Morse code, because of its complex encoding pattern and ON-OFF J38 Keying technique. So, in order to facilitate communication they can use this device where only the knowledge of alphabets and numbers is sufficient. With this design they will able to telegraph important messages with alphanumeric keypad and also read the messages from LCD screen. Using Microcontroller this device can encode and decode messages of International Morse Code.

INTRODUCTION

The "Morse code" is one of the greatest and ancient languages in the world that is used to transmit the information secret. It cannot be easily understood by the human beings because the Morse code is in the form of dots (.) and dash (-) format. Even though Morse code is 160 years old technology, but it is still being used as one of the present day communication technologies. Before the invention of telephone and telegraph communication systems, people got used to communicate with the help of Morse code technology. The text code is converted to Morse code by using a Morse code encoder.

The Morse code is a method of sending information by entering in a series of electronic pulses which represents as a short pulse (called a "dot") and long pulses (called a "dash"). The entire message will be sent by using these two characters or signals. If you want to send "EDGEFX TECHNOLOGIES" in Morse code, it will be converted to " . -.. –. . ..-. -..- — . -.-. …. -. —.-.. — –. .. . …" and sent to the receiver.

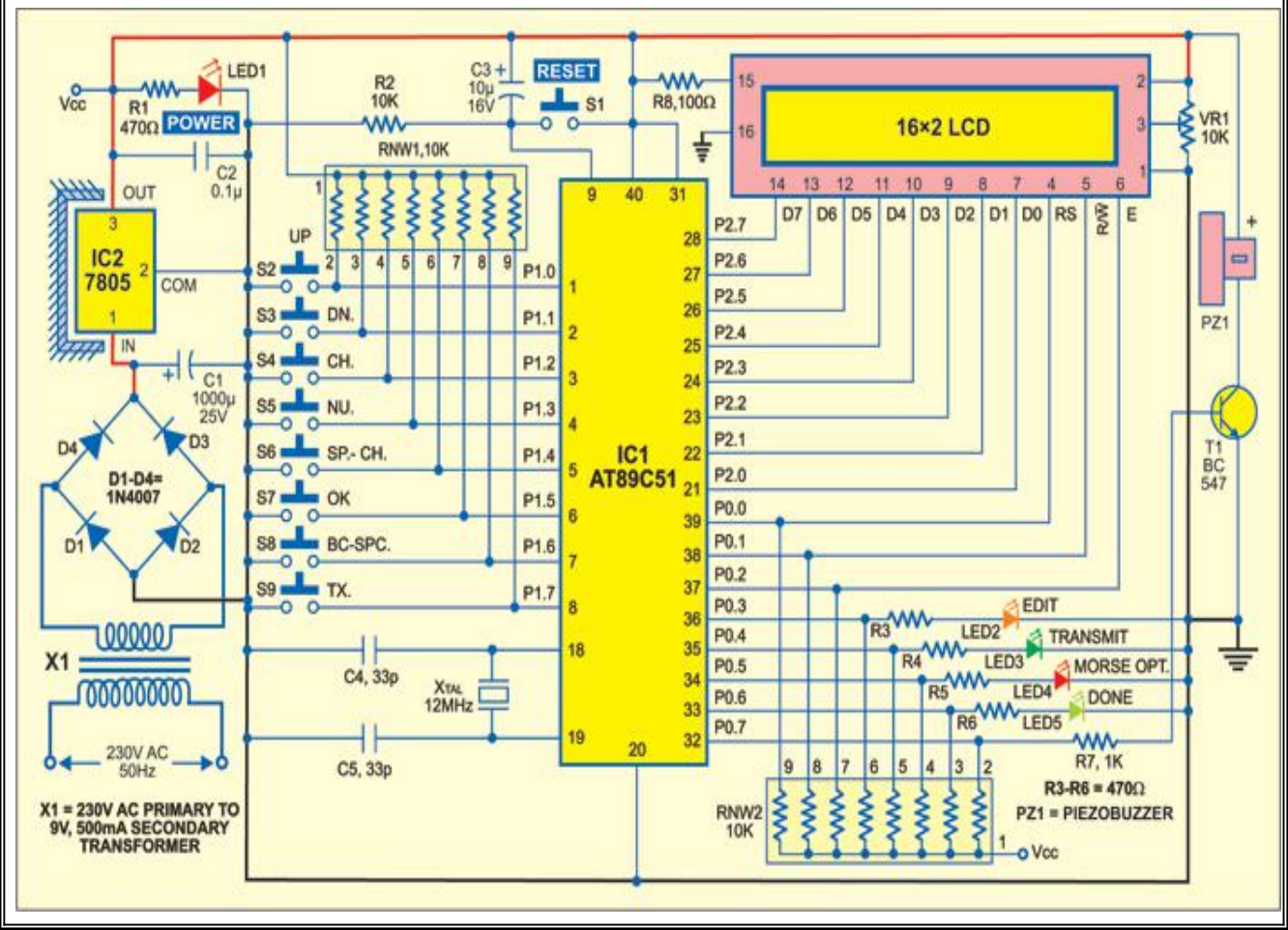
BLOCK DIGRAM OF MORSE CODE ENCODER



The Morse code encoder presented here converts texts, numbers and special characters into Morse code as audible output on a Piezo-Buzzer (PZ1). The encoder along with any Morse code transmitter can be used for transmission of Morse code.

Figure above shows the block diagram of the Morse code encoder. The Morse code message is entered through a keypad made of tactile switches 2 through S9 (Fig. 2). The message appears on the LCD for visual checking. LEDs indicate the applied command. The transmitted Morse code message is played on a Piezo-Buzzer and indicated by the glowing of LED4.

CIRCUIT DIGRAM



EXPLANATION

Figure above shows the circuit of the microcontroller-based Morse code encoder. It comprises microcontroller AT89C51 (IC1), regulator 7805 (IC2), and LCD display and a few discrete components. Micro Controller AT89C51 is the heart of the circuit. It is an 8-bit microcontroller with 4kB Flash programmable and erasable read-only memory (PEROM), 128 bytes of RAM, 32 input/output lines, two 16-bit timers counters, a five-vector two-level interrupt architecture, a full-duplex serial port, on-chip oscillator and clock circuitry.

Port pins P1.0 through P1.7 of the microcontroller are connected to switches S2 through S9 that are used for inputting the various commands. These port pins are pulled up with 10-kilo-ohm resistor network RNW1. Data pins D0 through D7 of the LCD are connected to port pins P2.0 through P2.7 of the microcontroller. The control pins—register select (RS), read /write (R/W) and enable E—are connected to port pins P0.0, P0.1 and P0.2, respectively. Preset VR1 is connected to pin 3 of the LCD for contrast control.

LED2 through LED5 are connected to pins P0.3 through P0.6 to provide the visual indication for 'EDIT,' 'TRANSMIT,' 'MORSE OPTICAL' and 'DONE' mode, respectively. Port pin P0.7 of the microcontroller drives the piezo buzzer with the help of transistor T1.

When the buzzer is kept in front of the microphone of a Morse code transmitter, text entered on the display gets transmitted. The Morse code receiver receives the transmitted code and decodes it to retrieve the message. Power-on reset is provided by the combination of resistor R2 and capacitor C3. Switch S1 is used for manual reset. A 12MHz crystal along with two 33pF capacitors provides the basic clock frequency.

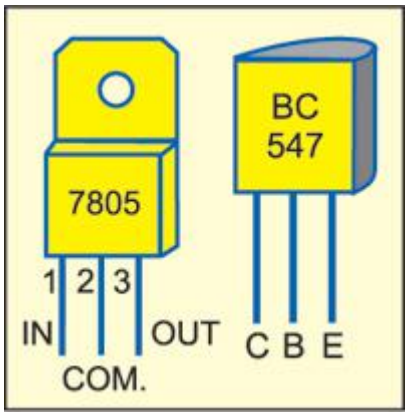


Fig. 3: Pin details of 7805 and BC547

To derive the power supply for the circuit, the 230V AC mains is stepped down by transformer X1 to deliver a secondary output of 9V, 500mA. The transformer output is rectified by a full-wave rectifier comprising diodes D1 through D4. The full-wave rectified output is smoothened by capacitor C1 and regulated by voltage regulator IC 7805 (IC2). Capacitor C2 bypasses the ripples present in the regulated supply. LED1 acts as a power indicator. Resistor R1 limits the current through the LED1.

MORSE CODE REPRESENTATION

The table shows Morse code of uppercase letters A through Z, numbers 0 through 9 and some special characters.

Morse Code of A to Z, 0 to 9 and Some Special Characters

Symbol	Code	Symbol	Code	Symbol	Code
A	.-	Q	--.-	7	--...
B	-...	R	.-.	8	---..
C	-.-.	S	...	9	----.
D	-..	T	-	0	-----
E	.	U	..-	,	--..--
F	..-.	V	...-	?	..--..
G	--.	W	.--	'	.----.
H	....	X	-..-	.	.-.-.-
I	..	Y	-.--	-	-....-
J	.---	Z	--..	"	.-..-.
K	-.-	1	.----	(	-.--.
L	.-..	2	..---	)	-.--.-
M	--	3	...--		-...-
N	-.	4	....-		
O	---	5	.....		
P	.--.	6	-....		

OPERATION

Translate keyboard Codes to ASCII Characters :

The ASCII stands for "American Standard Code for Information Interexchange" that is a type of code for data transmission. In embedded system the data will be stored in digital form. There is no way to store characters directly. Each character has its digital code equivalent is called ASCII code. The key code array contains all keyboard codes that can be recognized by the program. There we find the ASCII code of character D is 0x23.

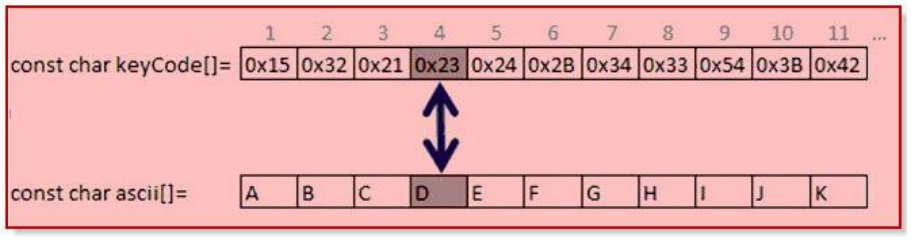


Fig. Translate the Keyboard Codes to ASCII Characters

Translate ASCII Characters to Morse Code:

Their PIC microcontroller also needs to translate among ASCII characters and Morse code in this above circuit. Here to follow the method for translate the ASCII character to Morse code that describe the program will search the position of the desired character and look for the corresponding Morse code.

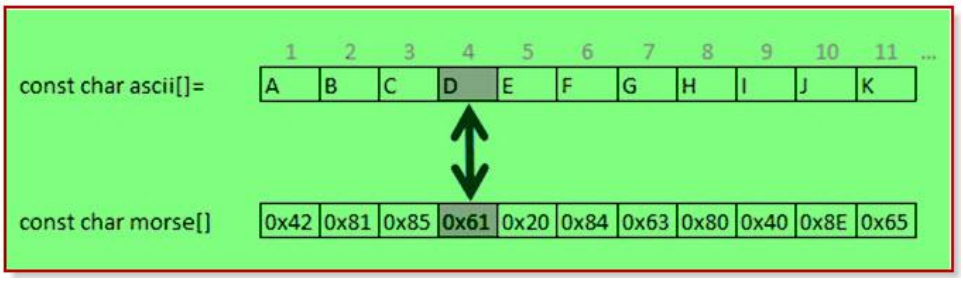


Fig. Translate the ASCII Characters to Morse Code

The Morse Code contains: a dot (.) or a dash (-) which is used to define the text messages. This is good because we can use the binary format to represent such code. A dot will be represented by the binary "0" while a dash is represented by the binary "1".The Morse code for our letter D is '-..' (1 dash followed by two dots). We need three bits to represent this number.

Most Morse characters only contain up to 5 marks (dots or dashes). We need 5 bits to represent such character. The PIC microcontroller has eight bits are reserved for each character, therefore we have unused bits 3. We used these to encode the length of each character. The following image shows the binary Morse data for the letter D (hexadecimal 0x61).

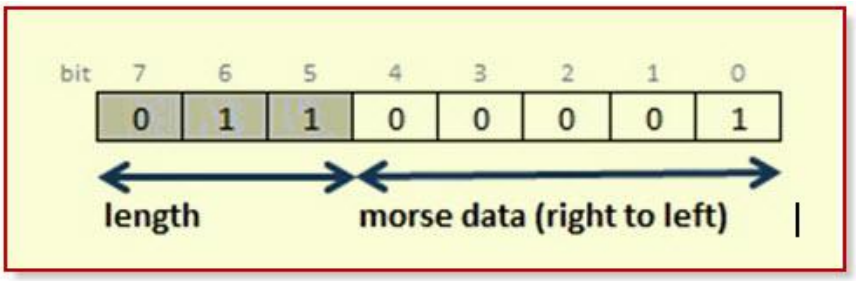


Fig. MORSE Code Data Frame

The bits 5-7 are used to indicate the length of the Morse character: the binary 011 (decimal number 3). They indicate that our Morse character contains 3 marks: bits 1,2 and 0.

PCB Functioning:

Power-on the circuit and press switch S1 to reset it. Let's say you want to transmit the message 'HELLO.' This message consists of alphabets, so press key S4 (CH.) to input capital letters from A to Z. Select letters from A to Z by pressing key S2 (UP) for forward movement of the alphabets and key S3 (DN.) for reverse movement of the alphabets. Once the desired alphabet is selected, confirm the selection by pressing 'OK' (S7) key. In a similar way, other letters of the message can be encoded. Every time you select a letter, it is confirmed by pressing S7 (OK) key.

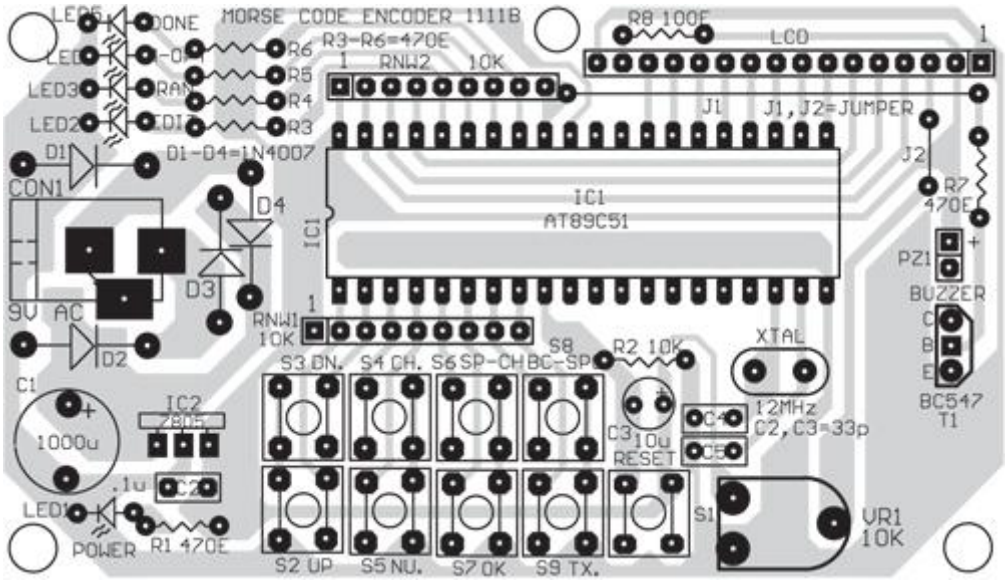


Fig. Component Layout of PCB

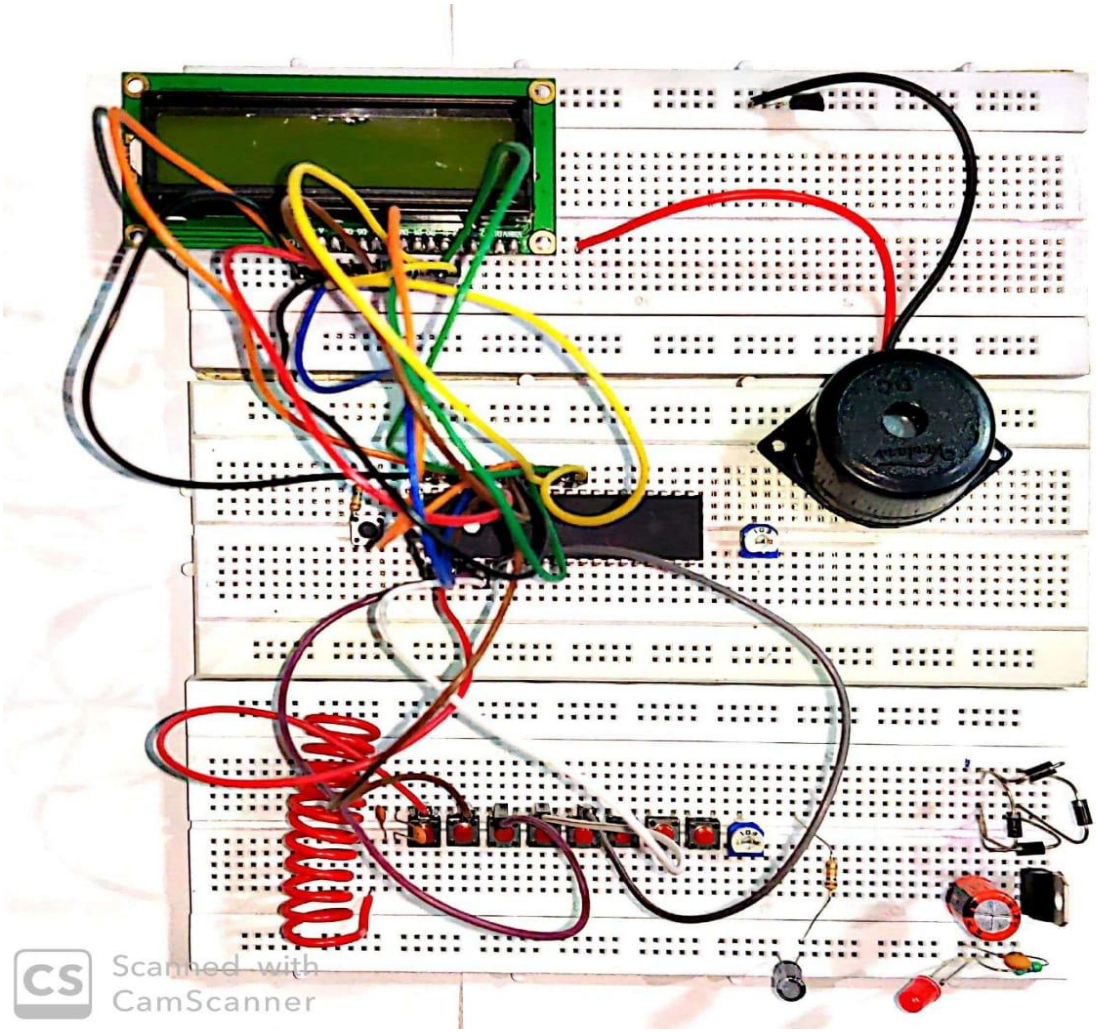
The message can consist of letters, numbers and special characters. For inputting numbers, press switch S5 (NU.). Select the desired number by using key S2 or S3. Confirm the selection by pressing S7 (OK) key.

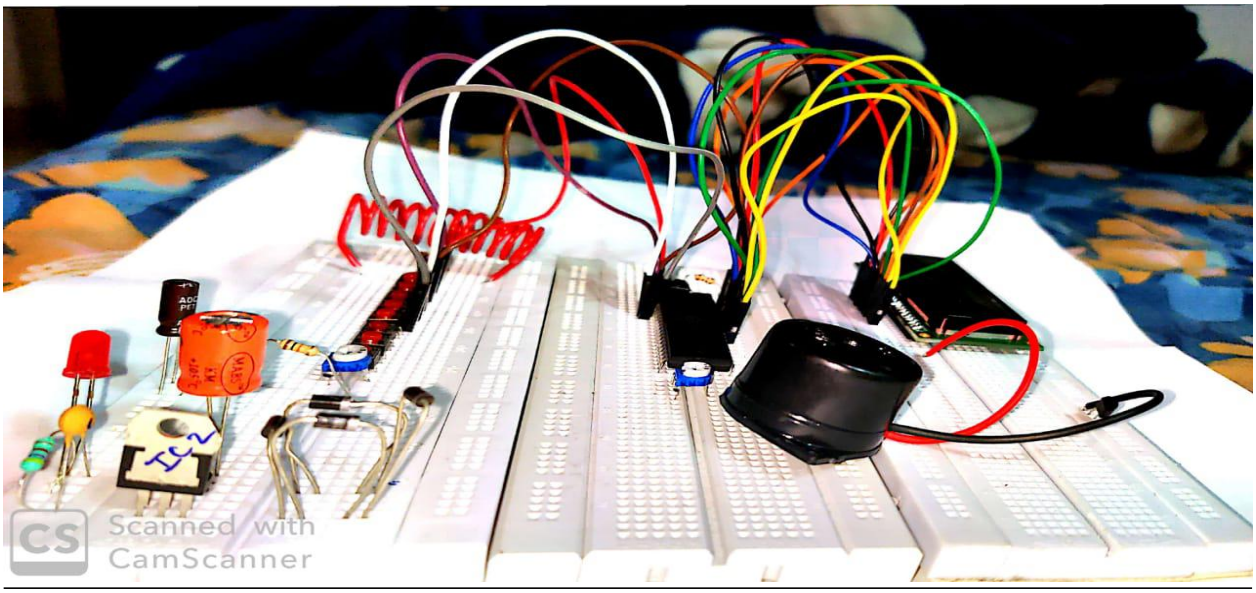
For inputting special characters (only nine special characters have been programmed in this encoder), press key S6 (SP.- CH.). Select the desired special character by using either key S2 or S3. Confirm the selected special character by pressing key S7 (OK). Every time key S7 is pressed, the cursor moves forward by one digit. To move the cursor backward by one digit, press key S8 (BC._SPC.). After the entire message is encoded, it can be heard as an audible tone from piezo buzzer PZ1 by pressing transmit key S9 (TX).

Edit mode is indicated by LED2, while transmit mode is indicated by LED3. After the desired message is transmitted, LED5 glows momentarily to indicate that transmission of the desired message is complete. LED4 glows for 500 milliseconds when a 'dot' is transmitted and for 1500 milliseconds when a 'dash' is transmitted.

IMPLEMENTATION

Hardware Connections:





Software Program:

This is a simple Morse Code program by using embedded C programming language with a switch statement. If you enter any character is given in the program to generate the respective Morse Code.

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
#include<process.h>
void main()
{
char str1[25],str2[100];
clrscr();
fflush(stdin); //clear the input buffer//
printf("enter the String");
gets(str);
int j=0;
for(int i=0;i<=strlen(str1);++)
{
    switch(toupper(str[i]))
    {
        case 'A':
            str2[j++]='.';
            str2[j]='.';
            break;
        case 'b':
            str2[j++]='.';
```

```
            str2[j++]='.';
            str2[j++]='.';
            str2[j]='.';
            break;
        case 'c':
            str2[j++]='.';
            str2[j++]='.';
            str2[j++]='.';
            str2[j]='.';
            break;
        case 'D':
            str2[j++]='.';
            str2[j++]='.';
            str2[j]='.';
            break;
        case 'E':
            str2[j]='.';
            break;
        case 'F':
            str2[j++]='.';
            str2[j++]='.';
            str2[j++]='.';
            str2[j]='.';
            break;
}
```

Applications of Morse Code Encoder

- **Aviation:**
  Morse code is used in the aviation field till today. Previously, they are used to maintain communication between planes or flights and also in ATC (Air Traffic Control). Today, they are used for giving navigation aids to the pilots and ensure that the stations, the pilots using are serviceable; the stations all transmit a short set of identification letters (usually a two-to-five-letter version of the station name) in Morse code.

- **Radio:**
  Morse code is still used in today communications like radio communication. It is mainly used by radio operators to communicate with each other and also used to distinguish from spark transmission from radio transmission. Still most of the radio amateur uses this Morse code to transmit radio.

- **Navy**:
  Navy people use this Morse code to send messages to other ships. They will send a distress signal or help to others ship when they are in need. If you see Titanic movie, you can observe that some people click one pointer to send message. That is Morse code signal. As the days change, they will send this distress signal in the form of audio, that audio is also in Morse code. Navy people will signal the other ship using the lights by switching ON and OFF in a code form; that sequence of ON and OFF of light is also in Morse code.

- **Normal Applications:**
  Morse code is still used by some people to send the distress signals, extensively used in military application and many more aviation submarines even by Government applications.

Result

Our results for this project represent the general concepts and methods behind Morse code. It was generally successful but not completely accurate. Our pulses are a bit longer than typical standard Morse code pulses. This is because shorter pulses demand a higher sampling rate, which in term means more memory. One of the problems in our project is the amount of memory available on the Mega32. Hence with longer pulses, we were able to sample at a lower rate and hence store less date. The pitch of the Morse code is also not the typical pitch you would hear. We are not much concerned about this because it is not something of great importance in demonstrating the Morse code concept. The microphone on the decoder is Uni-directional, hence it does not take in speaker output very well. We instead used a Uni-directional earpiece to input the Morse code into the microphone. But overall, the project was successful and worked.

When we have floating point operations, the sound outputted by the encoder has lagged, and the wave form became distorted. We have resolved that issue, and the encoder and the decoder ran concurrently without a problem. We have placed a second silence before the sound was outputted, but on purpose so we don't miss anything as we tested, and changed the volumes. As for the decoding, with a few exceptions, the Morse Code signal has been decoded back to its original signal.

The outputted and recorded sound waves are very accurate, as we checked the input and output wave forms on the oscilloscope. Since the device consists of speakers and microphones, the only safety issue that we needed to pay attention to was the output of the speakers, and nothing went wrong with that. The only interference that we could have had was the Morse code playing loudly on the speakers, but to prevent that, we used earphones as means of outputting sounds.

Our encoder/decoder device is very easy to use, and can be used as a tool/method for some people to aurally practice learning Morse code by listening to what they typed, and the other way around too.

Conclusion

Thus this project gives successful implementation of the Morse code encoder and decoder circuitry. Information could be easily transmitted in the form of dots and dashes through the keyboard to obtain decoded output on the LCD in the form of alphabets and numbers. The circuit is very simple to implement and Morse code has high security as only skilled and learned persons can decode the information. This method of communication has got dual benefit of good bandwidth efficiency and low transmission power as compared to the other complex coding schemes used in communication. Also it is comparatively more immune to interference both natural and man-made. Morse code no longer remains only the language of dots and dashes used in telegraph but it has also found a great scope in the fields of aviation to communicate with the base station, in navy to communicate with different ships, radio communication like the Amateur Radio, and recently has proved to be a great boon and an important communication tool for the people with various disabilities to communicate.

Future Scope

If we were to take this project one step further, possible improvement might include:

1. Adding external memory to all transmission of long strings
2. Making pulses shorter
3. Change the pitch of the Morse code
4. Adding a tap button so the user can directly input the Morse code to the decoder
5. Add human voice to the decoder so each decoded word gets spoken

We did not reuse anyone else code. We used bits and pieces of our low code from previous labs for some of the elements. In general, Morse code is not a system that is patented so anyone could use it. We do not think there are any commercial opportunities for this project since Morse code is pretty obsolete in today's society. Better and more accurate ways of communication has developed to replace the old Morse code technology.

Future scope of our project is to build full fledge Morse code based communication system. There can be another kind of signal that can be used for Morse code based communication system - Light Signal. But the limitation is that this communication is line of sight. Such system is used by coast guard or navy in some applications as a manual communication system, where a person transmitting Morse code using light understands the c ode well and person at receiving end should be able to decode the code manual by looking at the light pulses being transmitted.

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