Assistive Device for the Speech Impaired

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Speech-impaired people have difficulty in communicating with normal people because the hand gestures used by them to communicate their information is not easily understandable; only trained people can understand these. Most expressions and emotions remain un-conveyed, sometimes even misinterpreted. So hand gestures (limited gestures) are not an effective method of communication for the speech-impaired people.

To take care of this issue, an assistive device can be used to enhance the passage of communication. Here, the assistive device consists of a specialised keypad in which each key corresponds to a pre-assigned recorded audio that can be played to convey the message by the speech-impaired person.

**Circuit and working**

The device consists of transmitter and receiver sections. In the transmitter section (Fig. 1), the keypad matrix is connected to digital input/output (I/O) pins 2-7 of Board1 (Arduino Uno), which is used as the input device. The microcontroller (MCU) on Board1 scans the key being pressed and sends a 4-bit code representing the key pressed to I/O pins 10 to 13 of Arduino board.

These four bits are transferred to HT12E encoder for conversion of parallel data into serial data, which is fed into the RF transmitter. It then transmits this serial data at 433MHz using ASK modulation. The 750k resistor determines the oscillator frequency of the transmitter side.

In the receiver section, the code is received using the RF receiver and data bits are decoded if and only if the extracted address from the transmitted code matches the pre-programmed address in HT12D address pins, thereby avoiding interferences from the commercially-available receivers.

If the decoded address and pre-programmed address matches, LED1 glows, which is connected at pin 17 of IC HT12D. A 33-kilo-ohm resistor (R8) determines the oscillator frequency of the receiver. The decoded output from HT12D is sent to Board2 (Arduino Uno). Arduino board is programmed to generate a binary code, which is sent to IC 74HCT154 decoder to further trigger voice IC APR33A3.

In response to the trigger from the decoder, the voice IC generates corresponding audio messages programmed earlier.

The number of I/O pins on Arduino board is insufficient to drive voice IC APR33A3. So,
Fig. 2: Circuit of the receiver section
74HCT154, a 4-to-16 decoder is used to drive the select pins of the voice IC (IC6).

For recording the voice, make REC pin of APR33A3 logic low by closing switch S17. Then, drive message switches (S9-S16) connected to APR33A3 to logic low, sequentially, as per the number of audio messages to be recorded. The chip will play back a beep and the message can then be recorded. When the pin is released, the chip will play back the beep twice to indicate that the message has been recorded.

To play back the message recorded, REC pin should be driven to logic high and then message switches (S9-S16) should be driven from logic high to logic low, and the message play back starts. (LM386 is a low-voltage audio power amplifier. The voltage gain ranges from 20 to 200.)

Construction and testing

An actual-size, single-side PCB of the transmitter section is shown in Fig. 3 and its component layout in Fig. 4. Similarly, an actual-size, single-side PCB for the receiver section is shown in Fig. 5 and its component layout in Fig. 6.

Assemble the circuit on the PCBs as it minimises time and assembly errors. Carefully assemble the components and double-check for any overlooked error(s). Use proper IC base for the MCU and other ICs.

Message switches at the receiver side and the number of switches at the transmitter side of the keypad may be increased as per requirement, depending on the number of I/O pins available on Arduino UNO boards.

CON2 is a 12-pin connector used to interface the transmitter side PCB with Arduino UNO (Board1) as per the pins mentioned on the component side as shown in Fig. 4.

Similarly, CON4 is a 5-pin connector and CON5 is a 6 pin connector used to interface the receiver-side PCB with Arduino UNO (Board2) as per the pins mentioned on the component side as shown in Fig. 6.

CON1 and CON3 are 2-pin connectors used to connect 9V battery. To program the MCUs in Arduino boards, use a USB-A-B cable to connect to your system.

For troubleshooting, verify the voltages listed in test points table.

Software

The source code of the transmitter side contains a 2D array for the
### EFY Note

The source codes of this project are included in this month’s EFY DVD and are also available for free download at [source.efymag.com](http://source.efymag.com).

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**Test Points**

<table>
<thead>
<tr>
<th>Test point</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP0, TP5</td>
<td>0V, GND</td>
</tr>
<tr>
<td>TP1, TP4</td>
<td>+9V DC</td>
</tr>
<tr>
<td>TP2, TP6</td>
<td>+5V DC</td>
</tr>
<tr>
<td>TP3</td>
<td>Serial data to TX1</td>
</tr>
<tr>
<td>TP7</td>
<td>Serial data from RX1</td>
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</tbody>
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**Fig. 5: Actual-size PCB pattern of the receiver section**

**Fig. 6: Component layout of the receiver section**