International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 09 | Sep 2020 www.irjet.net p-ISSN: 2395-0072

CONTACTLESS TELEPHONE DIALING

An Application to Cope with COVID-19 Pandemic

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Abstract - *The next development in Human Machine Interface (HMI) technology is touchless sensors, which is the descendant of touch screen technology. Infrared (IR) proximity sensors are going to play very significant role in the next user interface innovations centered on touchless controlling applications. Frequent touching a touchscreen display may cause any scratch due to major problems can result in the gradual de-sensitization of the touchscreen to input and can ultimately lead to malfunction of the touchscreen. COVID-19 has accelerated this contactless technology to prevent the spread of infectious virus. Touchless technology will witness growth much faster than earlier due to the COVID-19 outbreak. The technology uses sensors to recognize your gestures, facial features or voice to complete a task. This paper will discuss on the touchless sensor based telephone solution for communication systems in harsh and critical sensitive environments.*

Key Words: *Human Machine Interface, Infrared*

1. INTRODUCTION

Telephone, an instrument designed for the simultaneous transmission and reception of the human voice. The telephone is inexpensive, is simple to operate, and offers its users an immediate, personal type of communication that cannot be obtained through any other medium. As a result, it has become the most widely used telecommunications device in the world. Billions of telephones are in use around the world.

This article describes the functional components of the modern telephone and traces the historical development of the telephone instrument. Also, it describes the development of what is known as the public switched telephone network (PSTN).

1.1 History

The word telephone, from the Greek roots tele, "far," and phone, "sound," was applied as early as the late 17th century to the string telephone familiar to children, and it was later used to refer to the megaphone and the speaking tube, but in modern usage it refers solely to electrical devices derived from the inventions of Alexander Graham Bell and others. Within 20 years of the 1876 Bell patent, the telephone instrument, as modified by Thomas Watson, Emil Berliner, Thomas Edison, and others, acquired a functional design that has not changed fundamentally in more than a century. Since the invention of the transistor in 1947, metal wiring and other heavy hardware have been replaced by lightweight and compact micro-circuitry. Advances in electronics have improved the performance of the basic design, and they also have allowed the introduction of a number of "smart" features such as automatic redialing, call-number identification, wireless transmission, and visual data display. Such advances supplement, but do not replace, the basic telephone design. That design is described in this section, as is the remarkable history of the telephone's development, from the earliest experimental devices to the modern digital instrument.

2. BLOCK DIAGRAM OF INTERNAL STRUCTURE OF TELEPHONE

2.1. IR sensor

IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range. Photodiode is a semiconductor which has a P-N junction, operated in Reverse Bias, means it start conducting the current in reverse direction when Light falls on it, and the amount of current flow is proportional to the amount of Light. This property makes it useful for IR detection. Indirect Incidence, both the IR LED and Photo diode are placed in parallel (side by side), facing both in same direction. In that fashion, when an object is kept in front of IR pair, the IR light gets reflected by the object and gets absorbed by photodiode. Note that object shouldn't be black as it will absorb all the IR light, instead of reflect. Generally IR pair is placed in this fashion in IR sensor Module.

Touchless Telephone use sensor based keypad to control Row & Column with the help of Relay. Relay 12v control the combination of row & column to generate a frequency via sense a respective number of Relay.

A standard telephone set consist of a transmitter, electrical network and a receiver for equalization, connected circuitry to control side tone levels and for regulating signal power, and required signaling circuitry.

In essence, a telephone set is an apparatus which creates an exact similarity of sound waves along with an electric

current. Figure 1 and Table 1.1 demonstrates the functional block diagram of a telephone set and the necessary elements of a telephone set.

Table.1.1 Elements of Modern telephone set

S. No	Elements of Telephone	Description
1	Ringer circuit	It alert the destination party of incoming calls. The audible tone by the ringer should be load adequate to be heard from a reasonable distance and offensive sufficient to make a person need to answer the telephone immediately possible.
2	Equalizer circuit	It is used to regulate the frequency and amplitude response of the voice signals.
3	On/off hook circuit	It is an easy single-throw, double-pole (STDP) switch placed across the tip and ring. The switch is mechanically linked to the telephone handset in order that when the telephone is idle or on hook, the switch is open. While the telephone is in use or off hook, the switch is closed completing and electrical path by the microphone in between the tip and ring of the local loop.
4	Hybrid circuit	This network enables full duplex operation over a two wire circuit. Fundamentally, the hybrid network separates the transmitted signals by the received signals.
5	Microphone	The microphone is the transmitter for the telephone. The microphone changes acoustical signals in the form of sound pressure waves by the caller to electrical signals which are transmitted in telephone net-work by the hybrid network.
6	Speaker	The speaker changes electrical signals received by the local loop to acoustical signals (as sound waves) which can be heard and understood by human being. The speaker is connecting to the local loop by the hybrid network.
7	Dialing circuit	This circuit enables the subscriber to output signals showing digits, and it enables the caller to enter the destination telephone number. The dialing circuit is either a Touch-Tone keypad or an electronic dial-pulsing circuit that sends various combinations of tones representing the termed as digits.

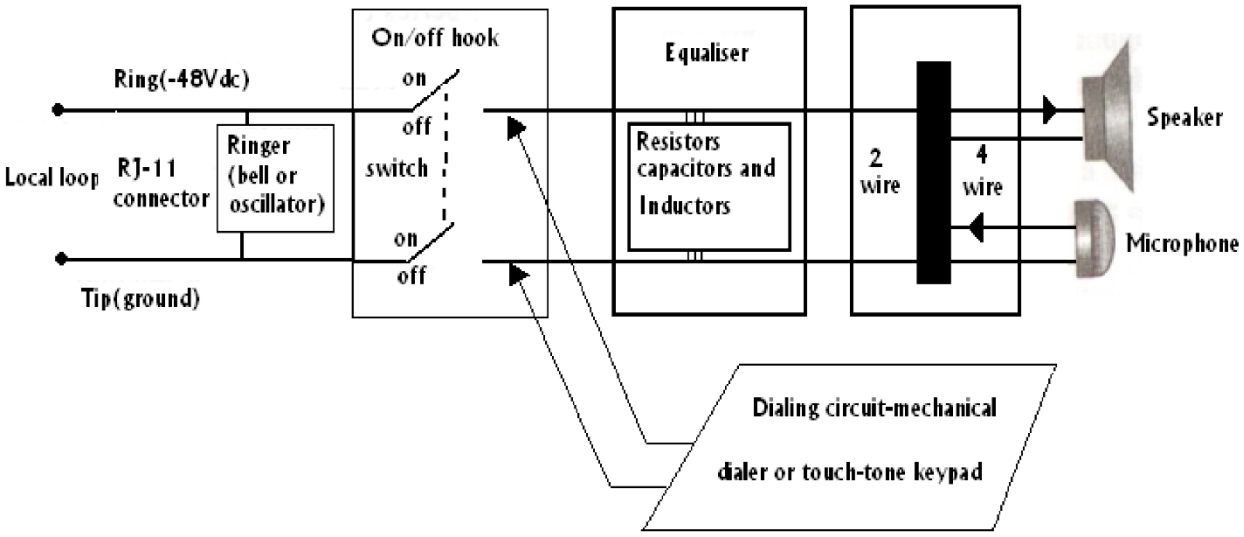

Fig -1: Functional Block Diagram of a Standard Telephone Set [1]

2.2 How does the Touch-tone Dial Telephone Operate:

The press of a button on the touch-tone dial telephone indicates the number dialed using certain frequencies. "Touching" or light pressing of a number generates a "tone" which is a combination of two frequencies, one from lower band and the other from upper band. For example, by pressing the button 9, two frequencies such as 852 Hz the lower frequency and 1477Hz the upper frequency are produced. The design of touch-tone dialing producing two frequencies is as shown below. The DTMF (Dual-tone Multi-frequency) dialing can be done through the touch-tone dialing technique.

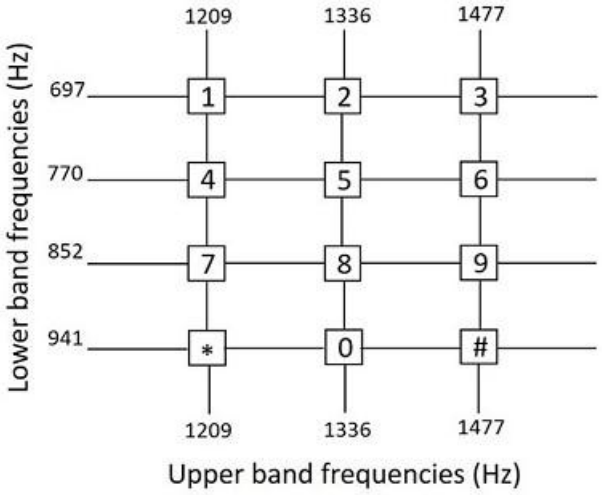

Fig-2. Touch-tone dialing producing two frequencies

2.3 Contactless Technology for Dialing:

While conventional touch buttons require users to touch them with their own skin, changing hygienic standards are demanding a different approach. Our contactless dialer works by using an innovative built-in IR sensor that detects when a call should be activated [2]. Users simple have to move a finger within a minimum proximity of 3 cm from the surface to activate the integrated sensor.

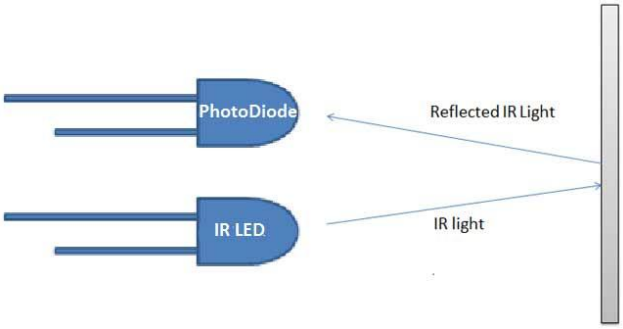

Figure.3. IR Sensor principle

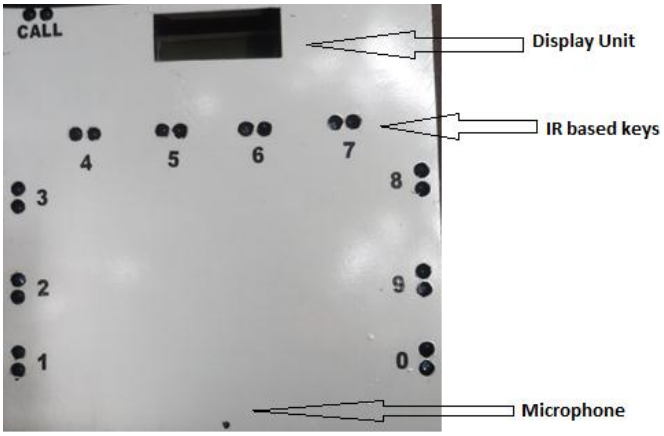

Fig-4. Prototype Designed

3. OPERATION FOR DIALING USING RELAY

In Touchless Telephone we used 5V & 12V DC Supply. Unregulated 12V DC supply Connect to Relay Circuit & 5V Connected to Sensor PCB.

When we turn ON the circuit there is no IR radiation towards photodiode and the Output of the comparator is LOW. When we take some object (not black) in front of IR pair, then IR emitted by IR LED is reflected by the object and absorbed by the photodiode. Now when reflected IR Falls on Photodiode, the voltage across photodiode drops, and the voltage across series resistor R2 increases. When the voltage at Resistor R2 (which is connected to the non-inverting end of comparator) gets higher than the voltage at inverting end, then the output becomes HIGH and Relay turns ON.

Voltage at inverting end, which is also called Threshold Voltage, can be set by rotating the variable resistor's knob. Higher the voltage at inverting end (-), less sensitive the sensor and Lower the voltage at inverting end (-), more sensitive the sensor.

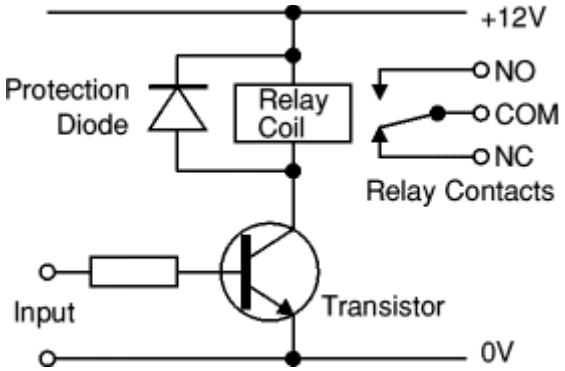

Figure.5. Relay Driver Circuit (Used in Key Pad Section)

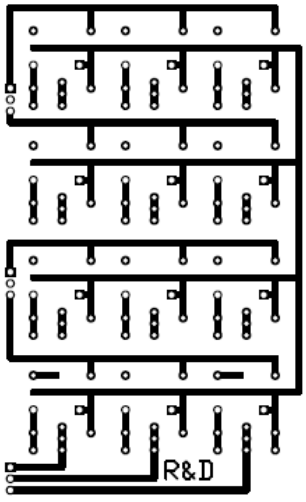

Figure.6. Relay Driver Circuit PCB Layout

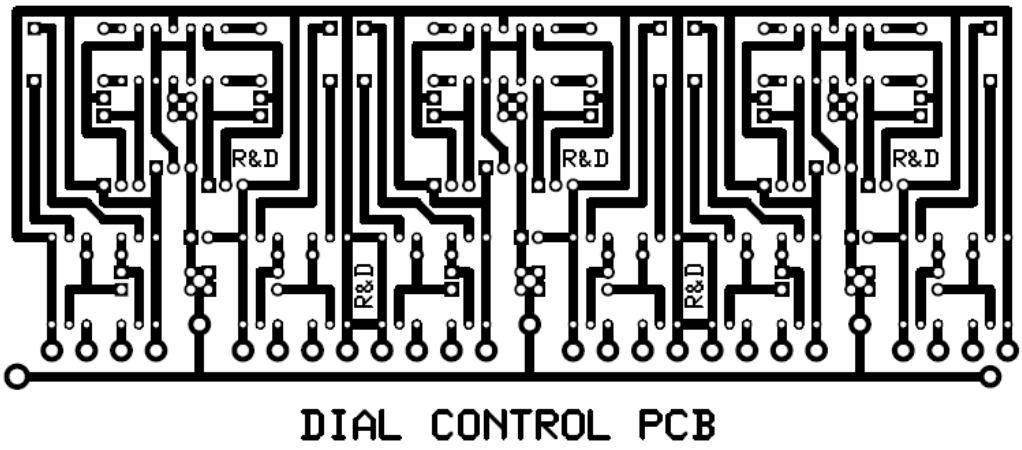

Figure.6. Dial control PCB layout

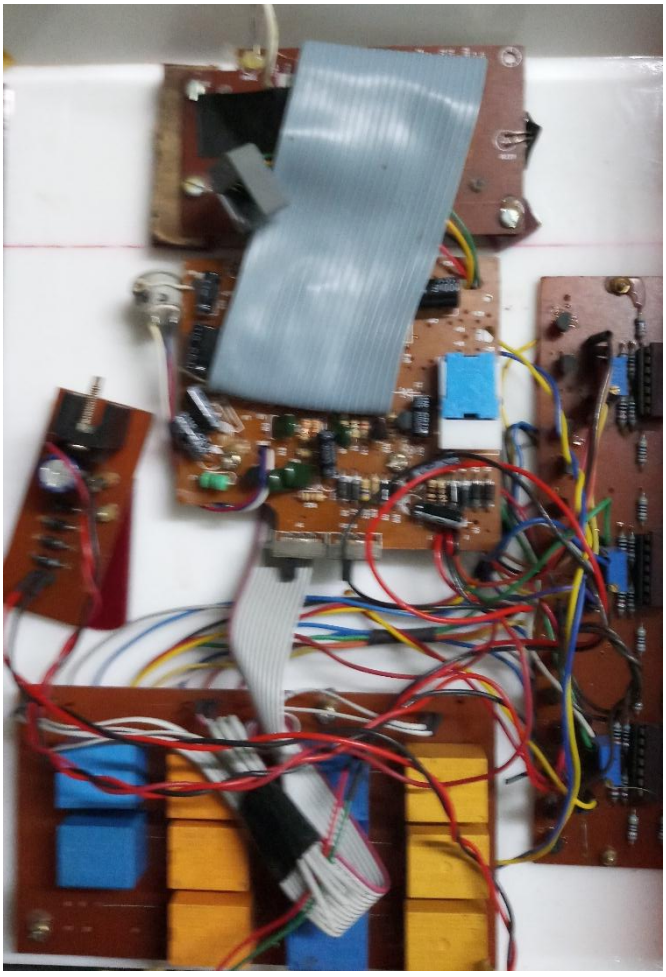

Figure.7. Complete Circuitry for designed prototype

4. CONCLUSIONS

With the continued spread of COVID-19, health organizations around the world are accelerating their adoption of technological solutions that mitigate the need for physical contact. Contactless innovations can reduce the spread of disease.

Touchless technology will witness growth much faster than earlier due to the COVID-19 outbreak. And in future it can be improved with voice based recognition.

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