A Novel Approach to Test Op-Amp Ic-741 Using Arduino

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Abstract- *Integrated circuits are the main component of each and every electronic circuit which is used for wide variety of applications. Developing from 1960's to the present technology the formation of integrated circuits have eased the process of constructing a circuit on PCB, with most of components imbibed during the construction of IC. It has also raised a problem to test and then implement IC's in circuits. As the faulty IC's malfunction the operation of the network. Indeed it is lot tedious work to debug the circuit and confirm whether the circuit is creating problem or the IC's itself is not working. So to come up with a solution to these sorts of problems we intend to design and implement an embedded system which would confirm whether the IC's under consideration is working properly or not. In the proposed concept the IC-741 is connected as a voltage follower. The square signal generated from Arduino Microcontroller is applied to the non inverting terminal of the Op-Amp (PIN 3). The inverting terminal is connected to output of the Op-Amp i.e. (PIN 2 is connected to PIN 6). Proper biasing voltage of* $\pm 9V$ *is applied to the biasing terminals under these connections Op-Amp circuit is expected to work like a voltage follower. If the IC under consideration is a "Working IC" then input square pulse appears at output terminal , Else the output will be null. The Arduino monitors the output terminal of the Op-Amp and if the signal read by the Arduino is say "101010101010….." the Op-Amp IC is working one and if the signal received is "000000000….." the Op-Amp IC is not working. An LCD is interfaced to Arduino to display the working condition of Op-Amp. An audio interface using DF player is also provided so that usage of this embedded system becomes easier.*

Keywords- IC-741, Op-Amp, Testing, Arduino.

I. INTRODUCTION

Operational amplifier in present-day is the most widely used electronics device in field of electronic systems such as communications systems, medical electronics, instrumentation, signal processing and performing many mathematical operations such as addition, subtraction, multiplication, integration and differentiations etc. It consists of various stages namely input stage, intermediate stage gain, level shifting stage and output stage and is fabricated as an integrated circuit. The symbol of typical op-amp is shown in fig.1.

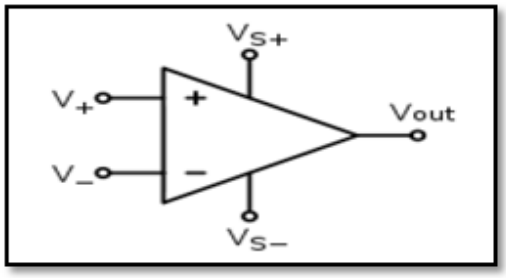

Fig1. Circuit symbol of Op-Amp

It has two input terminal named inverting (V-) and non inverting terminal (V+) and one output terminal (Vout). +Vcc and -Vcc are biasing terminals.

The ideal operational amplifier has following characteristics:

i. Infinite input impedance
ii. Zero output impedance
iii. Voltage gain is infinite
iv. Bandwidth is also infinite
v. Slew rate is infinite
vi. Common mode rejection ratio is infinite
vii. Input Offset voltage is zero

But physical op-amp is not ideal. A physical op-amp has large voltage gain, high input impedance and small output impedance. The block diagram of op-amp is shown in fig.2.

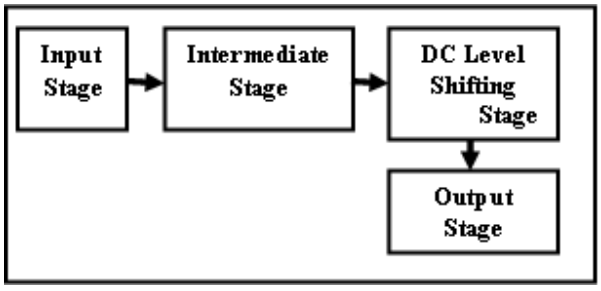

Fig 2. Block diagram of Op-Amp

The Op-amp can be used in two configurations namely Open loop configuration and closed loop configuration. The open loop configuration is one in which no feedback in any form is fed to the input from the output where as closed loop configuration is one in which a fraction of output or complete output is fed back to input. A few limitations of open loop configurations are: 1. clipping of output waveform may occur if output voltage exceeds saturation voltage of op-amp. 2. Open loop gain is not constant 3. Bandwidth is negligibly small. 4. This is the basic drawback of this configuration and hence is not suitable for AC applications but it finds use in non linear applications such comparators, square wave generator and astable multivibrator. The closed loop configurations finds its utilization in linear applications such adder, Transconductance amplifier, instrumentation amplifier, integrator, differentiator, log and antilog amplifier.

Operational amplifiers which have origins in analog computers are used in many linear, non-linear and frequency-dependent circuits. Characteristics of a circuit using an op-amp are set by external components with little dependence on temperature changes or manufacturing variations in the op-amp itself, which makes op-amps popular building blocks for circuit design. The various applications of op-amp is shown in fig.3.

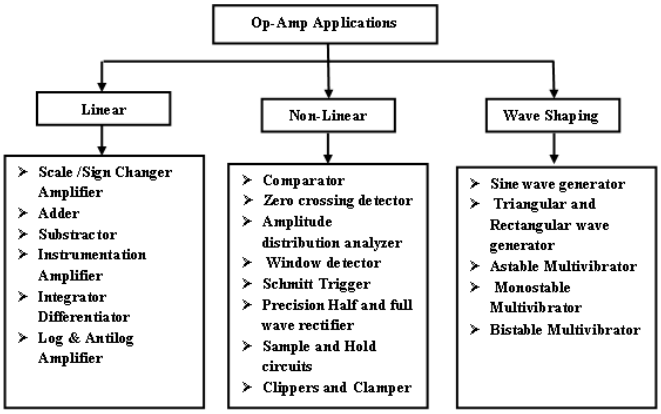

Fig.3 Various Applications of Operational Amplifier

II. MOTIVATION

Many embedded systems are developed by various vendors such as Texas Instrument, Kitek Technologies Private Limited, Aykay Electronics, Advance Tech India Private Limited and many more to test various digital integrated circuits. But very few have worked for analog IC's.

Without proper testing equipment for troubleshooting the components it is difficult to identify the reason for faulty operation of the network. Hence we thought to build an embedded system that allows testing of IC-741 and detects healthier IC for usage in the network.

The proposed system is user friendly and expected to user interface which guides the user about the usage of the embedded system.

III. PROBLEM STATEMENT

Integrated circuits play a huge role in operation of the circuits. Identifying the condition of Integrated circuits before placing them in the circuit is of importance. There are many embedded system to test the condition of digital IC's but there are no embedded system which test the condition of IC-741. The applications of IC-741 are huge which covers both linear and non-linear domain. It is essential to test and then install the IC-741 in any network**.**

IV. OBJECTIVE

The fundamental objective of the proposed system is to design and implement a user friendly embedded system to test the condition of an IC-741. The designed embedded system should also provide audio visual interface to convey the status of the IC-741.

V. METHODOLOGY

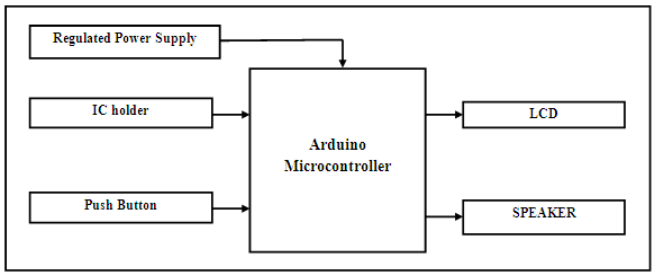

Fig.4 Block diagram of the proposed concept

In the proposed concept, the Arduino microcontroller generates square wave which is applied as input to the non inverting pin of IC-741, the Op-Amp is configured to work as voltage follower. As the square signal is applied as input, the output from the Op-Amp is expected as square wave only which is monitored by the Arduino. If the signal read by the Arduino microcontroller is "1010101010" then the Op-Amp is said to be in working condition and if the signal read by the Arduino microcontroller is "0000000" then the Op-Amp is said to be damaged. An LCD is interfaced with the Arduino microcontroller to display the working condition of the Op-Amp.

The speakers are driven through the DFY MP3 Player which is interfaced with Arduino microcontroller which also provides status of the IC-741 audibly.

VI. IMPLEMENTATION OF THE PROPOSED CONCEPT

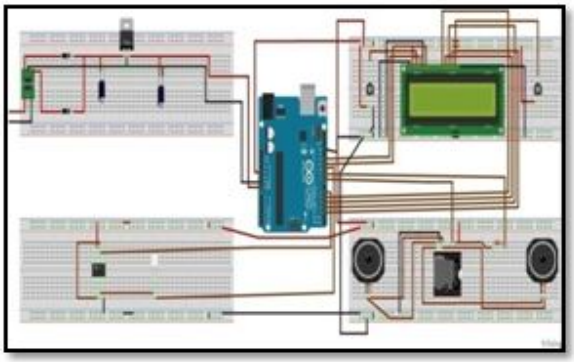

Fig.5 Proposed embedded system

The above fig.5 represents the circuit diagram of implemented concept. In the above circuit, the IC-741 is connected as a voltage follower. The square signal generated from Arduino Microcontroller is applied as input to the non inverting terminal of the Op-Amp (PIN 3). The inverting terminal is connected to output of the Op-Amp i.e. (PIN 2 is connected to PIN 6). Proper biasing voltage is applied to the biasing terminals of Op-amp, under these connections Op-Amp circuit is configured to work like a voltage follower. If the IC under consideration is an "Working IC" then input square pulse appears at output terminal. Else the output will be null. The Arduino microcontroller monitors the output terminal of the Op-Amp in the process if the signal read by the Arduino is say "101010101010….." the Op-Amp IC in consideration is an working one and if the signal read is "000000000….." the Op-Amp IC in consideration is faulty one.

An LCD is interfaced to Arduino microcontroller to display the working condition of Op-Amp. It displays a message as "Op-Amp is GOOD" if IC under test is a working IC. If the IC under consideration is a faulty then it displays a message as "Op-Amp is BAD".

An audio interface is provided using DFPlayer so that usage of this embedded system becomes easier. The audio system provides an interaction and guides to use the embedded system and also provides an acknowledgement of the test conducted by reporting the status of IC.

The following image shows hardware implementation of the proposed concept.

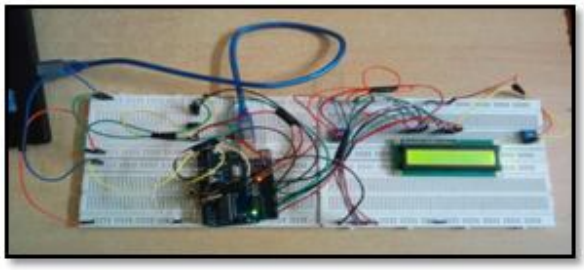

Fig. 6 Hardware implementation of the circuit

The following are the results obtained during testing of IC-741. Basically two IC where used to demonstrate the working of the designed embedded system. The first IC used to test the embedded system was in the working condition and the implemented embedded system indicated the same. The following figure illustrates the result depicted by the designed system.

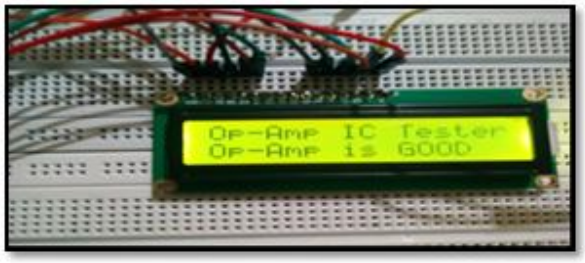

Fig. 7 Testing of working IC-741

The second IC used to test the embedded system was not in the working condition and the implemented embedded system indicated the same. The following figure illustrates the result depicted by the designed system.

Fig. 8 Testing of Non-working IC-741

VII. FLOWCHART FOR THE IMPLEMENTED CODE

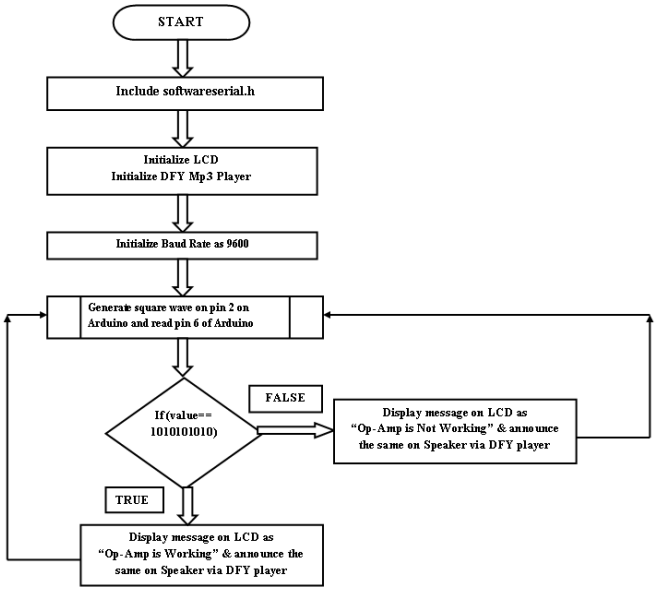

Fig.9 Flowchart for the implemented code

An Arduino UNO is used as a controller in the proposed system, square wave is generated by the Arduino on its pin number 2 which is applied as input to the Op-Amp non inverting terminal and as Op-Amp is configured as Voltage follower the square wave is expected to be read by Arduino at its pin number 6. If the signal read by the Arduino is found to be "1010101010" then a message is displayed on LCD "Op-Amp is GOOD" else a message is displayed on the LCD saying "Op-Amp is not BAD" and same message is provided by the speakers interfaced with Arduino via DFY Mp3 player.

VIII. CONCLUSION

The project implemented is a user friendly embedded system which allows identifying the working condition of IC-741. As the embedded system implemented was tested with 10 different IC-741 with 6 working IC and 4 faulty IC the results provided by system matched with 100% accuracy in identifying the working status of IC-741.

IX. FUTURE SCOPE

With the ever growing technology we can develop an embedded system which provides a platform to test both analog and digital IC on same platform. The system can be interfaced with memory so that results of previously tested IC could be stored in the memory and could be displayed if required.

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