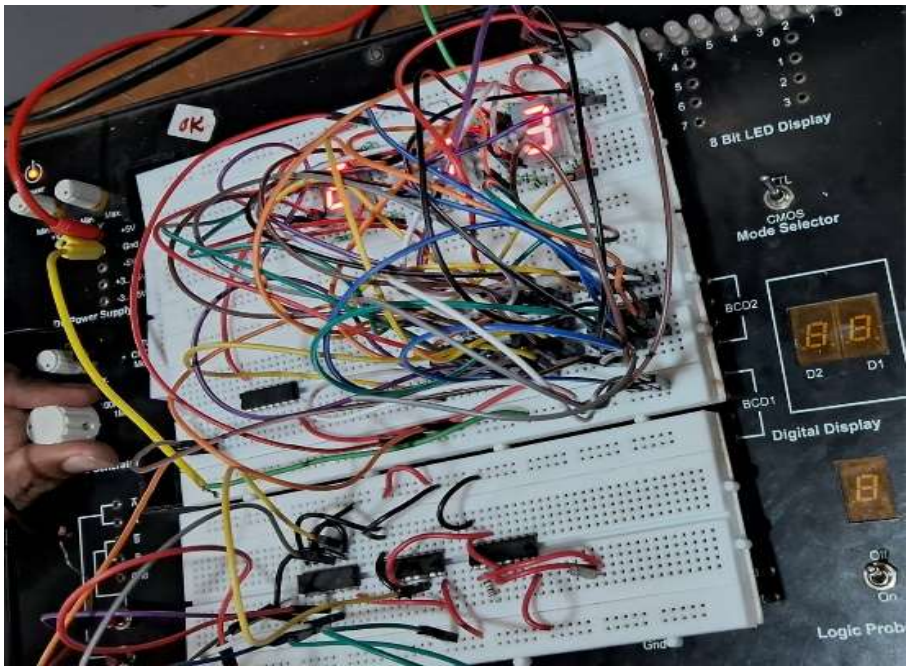
विश्वेश्वरय्या राष्ट्रीय प्रौद्योगिकी संस्थान, नागपुर, भारत
Visvesvaraya National Institute of Technology, Nagpur, India
AN INSTITUTE OF NATIONAL IMPORTANCE

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

DIGITAL CIRCUITS PROJECT

FREQUENCY COUNTER



SUBMITTED BY:

NISHITA PATEL	BT23EEE022
SHREYANSH RASTOGI	BT23EEE023
YASH KHARCHE	BT23EEE024

Introduction

This project aims to design and implement a frequency counter using digital ICs 4026 and 4013, along with a 7-segment display. The frequency counter is a crucial tool in electronics and communication systems, allowing users to measure the frequency of a signal.

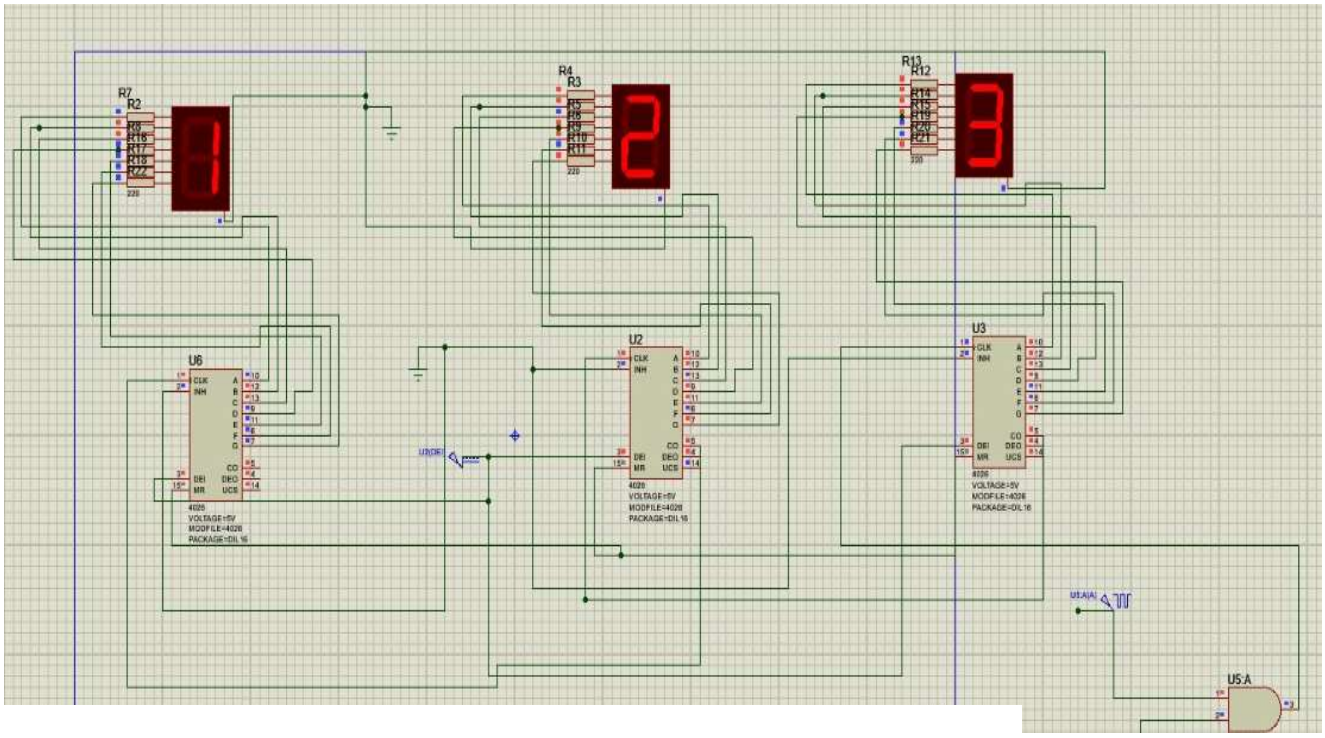
Components Required:

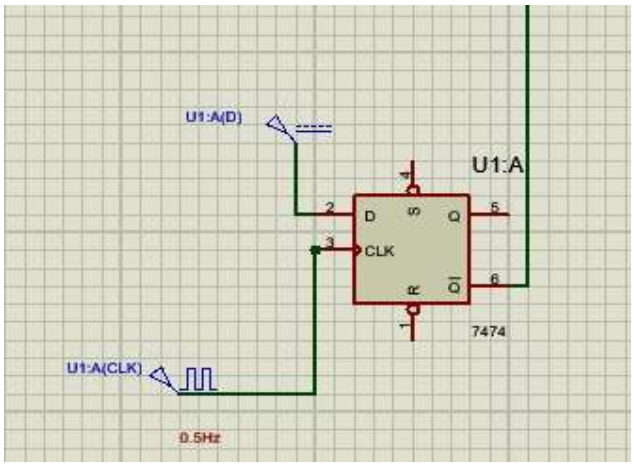
Component	Quantity
IC 4026	3
IC 4013	2
IC 4060	1
Crystal oscillator	1
7-Segment Display	3
Resistors	As needed 220 ohms, 330K ohms
Breadboard/PCB	2
External Clock Source	1
Connecting wires	As Required
Power supply	5V/9V

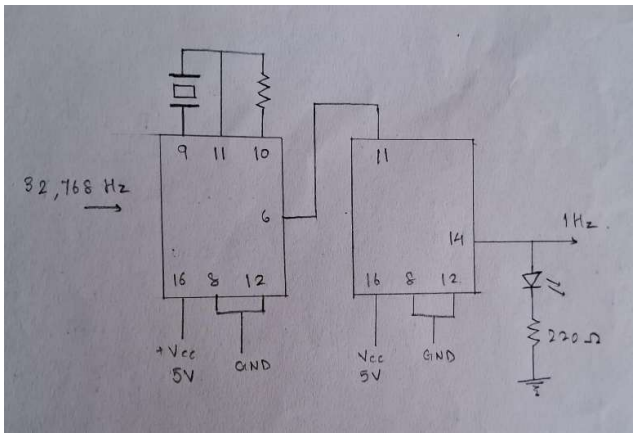
Functions of components:

- **IC 4026 (3 units):** Acts as a decade counter and 7-segment display driver. It receives clock pulses and drives the display accordingly.
- **IC 4013 (1 unit):** A dual D-type flip-flop used for signal conditioning, edge detection, or frequency division.
- Frequency Division: A D flip-flop toggles its output on each clock pulse when the D input is held high. This effectively divides the input frequency by 2. This is useful if the input frequency is too high for direct counting by IC 4026.
- **7-Segment Display (3 units):** Displays the numerical output of the count.
- **Resistors:** Used for current limiting and setting up logic levels.
- **Breadboard:** Platform for assembling the components.
- **External Clock Source:** The input signal whose frequency is to be measured.
- **IC 4060 with Crystal Oscillator:** Used to generate a stable clock pulse of 1 Hz. The IC 4060 is an oscillator-cum-divider IC. With a crystal connected to its internal oscillator pins, it produces highly stable low-frequency output. This acts as a time base for the frequency counter, ensuring accurate measurement within fixed intervals.
- **Connecting Wires:** Used for interconnecting the circuit elements.

CIRCUIT DIAGRAM:







Circuit Description:

- **IC 4026** is a decade counter with an in-built 7-segment decoder/driver. It directly drives a 7-segment display and increments count on every clock pulse.
- **IC 4013** consists of two D flip-flops and is used here to clean up the signal edges or divide frequency if needed.
- Connect 1 Hz from output of IC4060 oscillator circuit to clock of **CD4013** (D flip-flop).
- Tie **D = Q'** (inverting feedback).
- Output **Q** will now toggle every 2 pulses → **0.5 Hz**.
- The **external signal** acts as the input whose frequency is to be measured.
- Each pulse from the external clock increments the count in IC 4026.
- The display shows the number of clock pulses (frequency) per gate interval.

Working Principle:

1. An external clock source provides pulses to be counted.
2. IC 4013 may be used to condition the signal if necessary (e.g., divide-by-2 or clean transitions).
3. Each valid rising edge increases the count in IC 4026.
4. The 4026 updates the 7-segment display with each pulse.
5. After a fixed gating period (manually set or externally controlled), the count on the display represents the frequency.

So why a 0.5 Hz Trigger?

A **0.5 Hz trigger signal has a period of 2 seconds (T = 1/f = 1/0.5)**. You can use **one half of its cycle (1 second)** as your gate time.

- When the 0.5 Hz trigger is **HIGH** (for 1 second) → the counter counts the pulses from the input signal.
- When it goes **LOW** (for 1 second) → the counting stops, and the counter can then display or process the result.

This method provides a **precise 1-second gate time**, making it easy to directly read frequency values in **Hz**.

Workflow:

1. IC 4060 along with crystal oscillator is generating frequency of 1 Hz.
2. The trigger required is 0.5 Hz so to divide frequency the D flip-flop is used.
3. To measure frequency, we only require count once and hence we require to stop counting automatically so another D flip-flop is used which makes output of crystal oscillator 0 after first count.
4. The input frequency (i.e. to measure) and trigger of 0.5 Hz is given to AND gate and its output is connected to the IC 4026 clock.
5. AND gate starts count when both inputs are high and after which one input becomes 0 and output to clock is 0, which stops counting.

Advantages:

- Simple and low-cost circuit.
- External trigger does not require to operate.
- Easy to understand and build.

Applications:

1. Frequency Measurement: Measuring the frequency of signals in electronic circuits.
2. Signal Analysis: Analyzing the frequency content of signals.
3. Frequency division: Can be used as frequency divider.

Conclusion:

- ❖ This project demonstrates the design and implementation of a frequency counter using digital ICs 4026 and 4013 with a 7-segment display.
- ❖ The circuit can accurately measure and display the frequency of input signals, making it a valuable tool in electronics and communication systems.