**SUMMARY OF FLIP FLOP APPLICATION , COUNTER AND REGISTER**

**BY**

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**COMPUTER ENGINEERING**

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**CERTIFICATION**

This is to certify that the report is written by MBA JONAH ABALI with matriculation number: 17/MHS01/187 in the department of Computer Engineering College of Engineering Afe Babalola University(ABUAD), Ado Ekiti during the 2019/2020 academic session under my supervision.

Student Signature/Date Supervisor Sign/Date

**DEDICATION**

I would firstly like to thank God Almighty of his protection and provision during this trying times. I would also like to thank my family for pushing me to greater heights and also to the school authorities for taking us online classes and not falling prey to such a drastic change.

**FLIP FLOP APPLICATION**

Flip flop are very versatile devices that can be used in a wide variety of applications including counting, storing of binary data, transferring binary data from one location to another and many more. Many of the applications of flip flops are categorized under sequential circuits. Some basic examples of flip flop include SR flip flop, JK flip flop, T flip flop and D flip flop, and these types of flip flop have various basic attribute. In the case of SR flip it has two(2) input and an output which when high it's set and when low it's reset. JK flip flop solved the problem of race condition by providing a scenario for toggle, D flip flop and T flip flop both have a single input the only difference is that D flip flop maintain the input as the output but T flip flop's output is the compliment of the input.

**FLIP FLOP SYNCHRONIZATION**

The basic feature of most digital systems are synchronous in their operation because most of the signals will change states in synchronism with the clock transitions. Asynchronous signals often occur as a result of a human operator's actuating an input switch at some random time relative to the clock signal. These occurrences can therefore produce unpredictable and undesirable results.

**DATA STORAGE AND TRANSFER**

One of the most important uses of flip flop is storing of data and information. These stored data may represent numerical values or any other form of data that has been encoded in binary which means that the data type can be converted to binary in order for the computer to understand and produce result. Register is the location where the data is being stored in the particular flip flop. Another basic performance which occur in a flip flop is the data transfer which involves the transfer of data from one register to another or from one flip flop to another.

**PARALLEL DATA TRANSFER**

This type of data transfer involves the transfer of data from one register to another using the D flip flop. The transfer of such data from one register eg X and Y containing various layers therefore transfer its data simultaneously and the transfer of data from X register to Y register is a synchronous transfer. One basic feature of parallel data transfer is that the contents of the various registers do not change.

**SERIAL DATA TRANSFER:SHIFT REGISTERS**

A shift register is a group of flip flops arranged so that the binary numbers stored in the flip flops are shifted from one flip flop to the next for every clock pulse. In [telecommunication](https://en.wikipedia.org/wiki/Telecommunication) and [data transmission](https://en.wikipedia.org/wiki/Data_transmission), serial communication is the process of sending [data](https://en.wikipedia.org/wiki/Data) one [bit](https://en.wikipedia.org/wiki/Bit) at a time, sequentially, over a [communication channel](https://en.wikipedia.org/wiki/Communication_channel) or [computer bus](https://en.wikipedia.org/wiki/Computer_bus). This is in contrast to [parallel communication](https://en.wikipedia.org/wiki/Parallel_communication), where several bits are sent as a whole, on a link with several parallel channels. The basic difference between serial transfer and parallel transfer is that in parallel transfer all the information is transferred simultaneously upon the occurrence of a single transfer command pulse no matter how many bits are being transferred while in the serial transfer the transfer of N bit of information requires N clock pulses. Parallel transfer is way faster than the serial transfer using shift register.

**FREQUENCY DIVISION AND COUNTIING**

Frequency Division uses divide-by-2 toggle flip-flops as binary counters to reduce the frequency of the input clock signal. In a case in which there is a binary counter, modulo M =2^N, where N is the number of flip flops, then the frequency of the most significant bit. A divide by N counter implies that it divides the input clock frequency by N ie; if you cascade four(4) flip flops then, the output of every stage is divided by 2, if you are taking the output from the 4th flip flops , then its output frequency is clock frequency by 16. Then we can notice that the MOD counters have a modulus value that is an integral power of 2, ie 2,4,8,16 and so as to produce an n-bit counter depending on the number of flip flops used and how they are connected.

**MOD NUMBER**

The MOD number indicates the number of states in the counting sequence. The MOD number of a counter also indicates the frequency division obtained from the last flip flop. In computing, the modulo operation finds the remainder or signed remainder after division of one number by another. The modulo is the remainder after dividing one number by another.

**SIGNAL FLOW**

It is the conventional in circuit schematics to draw the circuits so that the signal flow in from left to right, with inputs on the left and outputs on the right. Therefore in some the counter diagrams which I learnt I discovered that conventional left to right signal flow was employed to achieve a successful digital system.

**PROPAGATION DELAY IN RIPPLE COUNTERS**

The ripple counters are one of the most popular and simplest types of counters (binary counters) because they require the fewest components to produce a given counting operation. This ripple counter has a major disadvantage due to the basic principle of operation which is propagation delay. Delay time is a time gap between the shot-instant and the shot-instant and the start of recording y a seismograph to avoid long, blank sections on a record. It is also used in time-domain induced polarization surveying to allow for the dissipation of transient voltages which have no direct relation to the overvoltage. A frequency divider is a circuit that takes an input signal of a frequency fin and generates an output signal of a frequency fout, where fout = fin / n and ''n'' is an integer. Frequency dividersare used for both analog and digital applications. Analog frequency dividers are used only at very high frequencies. The total delay between clock input and FF3 JK input is up to 2+3+3 = 8ns. Therefore the minimum acceptable time between clocks is 8ns + JK setup time. So long as this timing is met the counter should work correctly, and the propagation delay will be 2ns because Q outputs only change in response to clock inputs.The total delay between clock input and FF3 JK input is up to 2+3+3 = 8ns. Therefore the minimum acceptable time between clocks is 8ns + JK setup time. So long as this timing is met the counter should work correctly, and the propagation delay will be 2ns because Q outputs only change in response to clock inputs.

**CIRCUIT OPERATION**

For a particular circuit to perform effectively various operations and rules must be taken such as toggle a scenario in which both input are HIGH then the present state will be toggled giving out the compliment as the next state which may be high or low depending on the present state. In electronics, a flip-flop or latch is a circuit that has two stable states and can be used to store state information – abistable multivibrator. The circuit can be made to change state by signals applied to one or more control inputs and will have one or two outputs.

**ADVANTAGES OF SYNCHRONOUS COUNTER OVER ASYNCHRONOUS**

The synchronous counter transfers all the data from one register to another simultaneously in which no data is lost and data still remains the same while in the case of asynchronous the data can be affected by propagation delay and the data won't be the same. The one advantage of synchronous counter over asynchronous counter is that it can operate on higher frequency than asynchronous counter as it does not have cumulative delay because of same clock is given to each flip flop. Synchronous counter eliminates lots of limitations which arrive in Asynchronous counter. It's easier to design than the Asynchronous counter. It acts simultaneously, no propagation delay associated with it. Synchronous counters are easier to design than asynchronous counters are all clocked together at the same time with the same clock signal. Due to this common clock pulse all output states switch or change simultaneously. Overall faster operation may be achieved compared to Asynchronous counters, less likely to end up in erroneous states. They are faster as the propagation delay are small as compared to asynchronous counters. There are no counting errors as compared to asynchronous counters. Performance is much better, liable and portable circuit. The major difference between them lies in their transmission methods, i.e. Synchronous transmissions are synchronized by an external clock; whereas Asynchronous transmissions are synchronized by special signals along the transmission medium.

**ACTUAL ICs**

There are various synchronous IC counters in both TTL and CMOS logic families which are used in different logic devices and serve their various purposes. ICs are now used in virtually all electronic equipment and have revolutionized the world of electronics. Computers, mobile phones, and other digital home appliances are now inextricable parts of the structure of modern societies, made possible by the small size and low cost of ICs. The integrated circuit uses a semiconductor material (read chips) as the working table and frequently silicon is selected for the task. Afterwards, electrical components such as diodes, transistors and resistors, etc. are added to this chip in minimized form. The silicon is known as a wafer in this assembly. Hundreds of integrated circuits are made at the same time on a single, thin slice of silicon and are then cut apart into individual IC chips. The manufacturing process takes place in a tightly controlled environment known as a clean room where the air is filtered to remove foreign particles. An integrated circuit, or IC, is small chip that can function as an amplifier, oscillator, timer, microprocessor, or even computer memory. An IC is a small wafer, usually made of silicon, that can hold anywhere from hundreds to millions of transistors, resistors, and capacitors. There are two types of IC manufacturing technologies one is monolithic technology and other is hybrid technology. In monolithic technique, all electronic component and their interconnections are manufactured together into a single chip of silicon. Monolithic ICs are cheap but reliable.

**STATE TRANSITION DIAGRAM**

A state diagram is a type of diagram used in computer science and related fields to describe the behavior of systems. State diagrams require that the system described is composed of a finite number of states; sometimes, this is indeed the case, while at other times this is a reasonable abstraction.

A diagram consisting of circles to represent states and directed line segments to represent transitions between the states. One or more actions (outputs) may be associated with each transition. The diagramrepresents a finite state machine.

What is the utility of state transition diagram?State-transition diagrams are very useful for describing the behavior of individual objects over the full set of use cases that affect those objects. State-transition diagrams are not useful for describing the collaboration between objects that cause the transitions.

**COUNTERS WITH MOD NUMBERS**

The Modulus (or MOD-number) of a counter is the total number of unique states it passes through in one complete counting cycle with a mod-n counter being described also as a divide-by-n counter. The modulus of a counter is given as: 2n where n = number of flip-flops.

**PRESETTABLE COUNTER**

This means when the LD input is high, then whatever binary value is present on LOAD INPUTS, will be immediately copied to the outputs and stay that way until LD goes low. This enables the counter to begin from any value, e.g count from 6 to 15. Note this only works if the RESET input is low.

**IC SYNCHRONOUS COUNTERS**

In synchronous counters, the clock inputs of all the flip-flops are connected together and are triggered by the input pulses. Thus, all the flip-flops change state simultaneously (in parallel). The circuit below is a 4-bit synchronous counter. The J and K inputs of FF0 are connected to HIGH.

**INTEGRATED CIRCUIT REGISTER**

These contain some circuits known as registers that store information. Registers are predetermined memory locations. Each processor has many different types of registers. Permanent registers are used to store the preprogrammed instructions required for various operations (such as addition and multiplication.

**SYNCHRONOUS DOWN&UP/DOWN COUNTER**

Counters are used in many different applications. Some count up from zero and provide a change in state of output upon reaching a predetermined value; others count down from a preset value to zero to provide an output state change. The counters are synchronous, but they are asynchronously presettable.