Determining the Shortest Current Flow Path Using Dijkstra's Algorithm in Mess Circuit

Chithambaramani. R, Prakash. M, Angel Latha Mary. S

Abstract*: Determining the Shortest path for the current flow needs to solve the mess circuit which is certain complex nature. So first, we need to solve the complexity of the circuit and reducing it in the simplest form using many theorems available in day to day life. But now as far as the sample complex circuit is concerned, the complexity of the circuit can be solved by using one of the theorems namely, Mesh current analysis. We need to solve the mesh equations by applying some basic laws involved in the mesh current analysis. It is very much useful in finding the current flow which is developed in that closed loop or path. Hence the shortest path for the flow of electric current can be found using Dijkstra's algorithm involved in the electrical circuits. This paper is proposed to identify the shortest path using Dijkstra's algorithm. for the flow of maximum current with high Power in the complex circuit using Mesh current analysis

***Index Terms*: Dijkstra's algorithm, Kirchhoff's voltage law Mesh Current Analysis.**

I. INTRODUCTION

Mesh Current Analysis is a technique which is used to find the currents circulating surrounding the closed loop, alternatively an mesh circuit. It is a technique that is utilized to explain the unpredictable circuits for the progression flow of current at anywhere in the electric circuits. Kirchhoff's law is used for mathematical representation of current flow with set of equation to predict the exact current flow in each closed electrical circuit. Basic law such as Ohm's Law and Kirchhoff's Voltage Law plays a vital job in the assurance of obscure flows in a system. In the Mesh Current strategy, we don't utilize Kirchhoff's Current Law. Thusly, we utilize just Kirchhoff's Voltage Law, we are ready to comprehend the circuit with less obscure factors and less which is even nice when we are forced to solve without the calculator.

Kirchhoff's Voltage law communicates that the aggregate of potential climbs and the entire of potential drops in a close loop is proportionate to zero. It is generally called Kirchhoff's second law. While Kirchhoff's Law gives us the essential methodology for looking at any complex electrical circuit, there are similarly even piles of different ways to deal with slapped together this procedure. One among that is by using Mesh Current Analysis, which incorporates the process of simplification including the Larger Networks which is even a fantastic favored angle for any Complex Electrical Circuit Provided

Dijkstra's Algorithm is utilized to decide the shortest current flow between hubs in a circuit of each Edge. It is otherwise called the eager calculation that takes care of the most limited way issue for a coordinated diagram G. It settles the single-source most brief way issue when all edges have non-negative loads.

In this paper we present the identification of shortest path for current flow in the mesh circuits. Section 2 provides detailed survey of past work carried out so far and Section 3 highlights the proposed architecture for maximum current flow in mesh circuit. In Section 4, we have discussed the implementation of maximum current flow in mesh circuit using a sample electrical circuits. Section 5 presents the conclusion and future work.

II. RELATED WORKS

Dijkstra's calculation [1] tackles the shortest current path issue from a given starting source of current to all different paths of current flow in the electrical circuit. It is utilized over the coordinated path of current flow with the non-negative loads of current between two different nodes. Here the calculation distinguishes two sorts of vertices; they are settled and unsolved nodes. At first, The origin of the current flow has been identified and check neighbor voltage, current or resistance source which initially an unsolved vertex, once add to shortest current flow circuit it becomes an settled vertex. Through greedy approach, it chooses the next neighbor to be visited from the unsolved vertex and uses breadth first technique and iterates over again to achieve the shortest current path. The calculation repeats until all vertices are understood and settled. Dijkstra's calculation accomplishes a period unpredictability of O (n2).

The major advantage of using Dijkstra's calculation is that, It is not necessary to visit all current, voltage and resistance sources. Major consideration of this approach when source of current, voltage or resistance changes dynamically it can't be applied or if it has negative source of voltage, current and resistance applied. Time complexity for finding shortest current flow in an planar graph using Kawarabayashi et al. [2] results O (nlog2n) but querying time Thorup's approach [3] for visiting all sources of the circuit is O (q-1) but Kawarabayashi et al [2] is O (q-2log2n). Conversely, just a subset of sources of current, voltage, resistance is secured utilizing Kawarabayashi et a[4] approach. The methodology is O (q-1) times the number of ways in space unpredictability. Arbitrary power-law charts has a space unpredictability of O (n4/3). Their methodology receives the separation prophet provided by Thorup and Zwick [5], where they

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utilize high-degree sources as tourist spots. The adjustment incorporates choosing spots with the most noteworthy degree as tourist spots. It encodes the briefest ways in the sources as settled. In [9] this information structure fundamentally consolidates geospatial information, for example, course diagrams and sensor charts. Moreover, it incorporates ecological information, for example, sensor readings to get constant hazard mindful departure arranging in crisis cases. This work is worried about indoor clearing. In this manner, the information model has been intended for that reason. The proposed information model, executed in a customized clearing framework, will permit the formation of a dynamic departure course for the focused on individuals. This framework relies upon the perusing of the present sensor and considers chance appraisals. The reasonable advantages of the model can likewise stretch out to a framework that connects a course organize with a sensor arrange for an assortment of indoor space applications. This framework can be extended to electrical circuit to find the shortest current flow.

Mesh current investigation [6] works, by discretionarily appointing the mess flows in the fundamental cross sections. It is likewise alluded to as a independent mess. A basic work in the circuit does not contain some other mesh. A mesh current [7] is a present which encompasses the vital mesh and the manual equation can be comprehended as far as Mesh current examination. It is the typical practice to have the whole mesh current circle a similar way, which helps in averting the blunders [6] while composing the fundamental equations.

The show is to have all the mesh flows circling a clockwise way. Rather than illuminating the flows utilizing Kirchhoff's voltage law [7] we can even decide the flows utilizing the Mesh current investigation with the goal that the measure of estimation is extraordinarily diminished. Each `closed loop must have a mathematical equation of current flow. Each mathematical equation of current flow combine to form a mesh current for the electrical circuit along with voltage drop and impedance in that each closed loop mesh circuit.

III. PROPOSED SYSTEM

Voltage source and Impendence in the electrical circuits[8] of each closed loop has been added or subtracted to the current flow equation based on voltage drop or high voltage. This mathematical equation are modeled using matrix algebra to set of linear mathematical equation of current flow can be solved using Cramer's rule has been applied for set of linear mathematical equation of current flow using determinant and using rank matrix method to replacing an column vector with another vector. It is one of the applications in Mesh current analysis, Then system of current equation has been modeled as a Graph G. Dijkstra's calculation start with the source of supply to the electrical circuit and uses visited matrix which initially set to false. If the node is added to shortest current flow path it is marked visited. From the source node identifies the next neighbor through greedy approach, it uses breadth first technique and iterates over again to findthe shortest current path. The above process is mentioned in Fig 1. Maximum Flow of Current in the Mesh Circuit

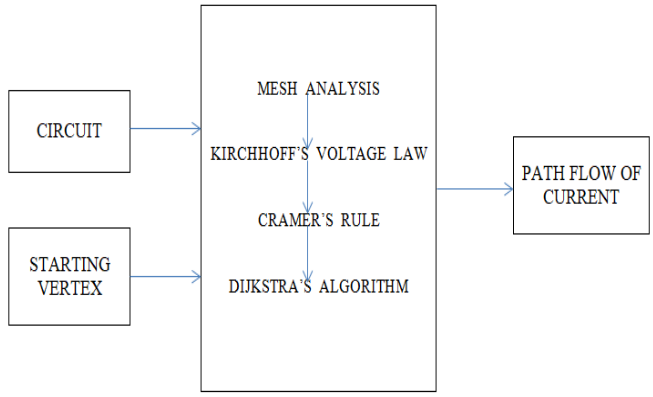

Fig 1) Maximum Flow of Current in the Mesh Circuit

Given an electrical mesh circuit along with the starting point of the current flow. We perform mesh voltage analysis using Kirchhoff's voltage law and mess current flow analysis using Cramer's Rule. Using voltage and current, we calculate the resistance of the each node. Then the electric circuit has converted to Graph G with weight as resistant, voltage and current. Now we apply dijkstra's algorithm to determine the shortest flow of current in the given electrical circuit.

IV. IMPLEMENTATION AND RESULTS

We have taken sample electrical circuit and applied mesh analysis using Kirchhoff's voltage law and Cramer's rule to determine the shortest current flow.

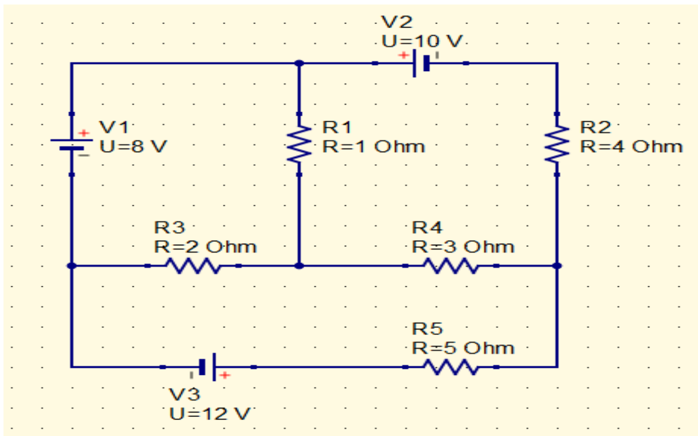

Fig 2) Electrical Circuit

For the electrical circuit available in Fig 2, we need to find the flow of current using Mesh Analysis. We can frame the current equations using Mesh Analysis. Mesh equations for the above circuit can be obtained by applying the equation of Kirchhoff's voltage law. We have three mesh equations for the above Circuit mentioned Table i, which can also be written as, Mesh Equations :

Table i) Mesh Equation

-(I1-I2)-R3(I1-I3)+V1=0
V2-R2(I2)-R4(I2-I3)-R1(I2-I1)=0
-R3(I3-I1)-R4(I3-I2)-R5(I3)+12=0

We can find the flow of Current using Mesh

Equations; the further calculations could be solved using Cramer's Rule. From the Mesh Equations we get the nxn matrix depending on the n-number of Equations and the n-unknown variables, such that the above circuit consists of three Equations from which three unknown variables are found. First we need to find the determinant of the three unknowns variables using Cramer's Rule. Then to find the unknown variables independently, we need to replace the unknown column using the equated values. Thus we can determine the unknown variables. (i.e.) Here in the above Circuit we need to find the three currents namely C1, C2, C3 using Cramer's rule in Table ii . Hence for the above Circuit we have calculated the currents C1, C2, C3 as Follows:

Table ii) Current flow using Cramer's Rule

$C1 = \Delta\ C1/\Delta$
$C2 = \Delta\ C2/\Delta$
$C3 = \Delta C3/\Delta$

Then the currents across the particular resistors can be calculated either by summing or finding the Difference between the currents is possible. Sometimes the current can also be the direct Current across the particular resistors. Thus the current across the particular resistors can be calculated.

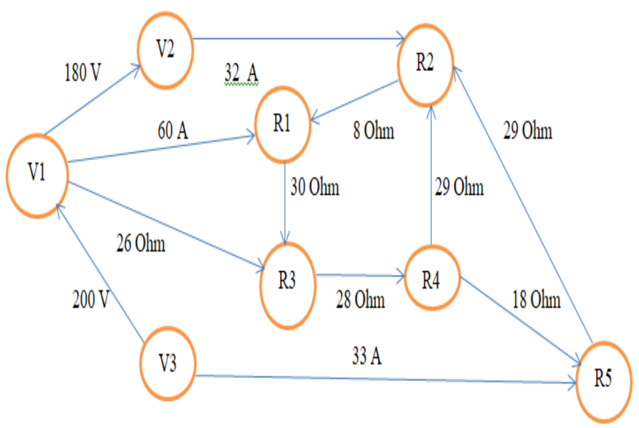

Fig 3) Electric Circuit to Graph G

The electric circuit has been modeled into graph using mesh analysis in the Fig 3. The edge cost has taken from the mesh equation and Cramer's rule.

As a result, the shortest path algorithm is widely used in networks. It is also employed as a subroutine in other algorithms. From the above Graph G, we obtain the Shortest Path of the flow of Current with the minimal Resistance values. The need for finding the shortest path of flow of Current is to get the maximum Power for the human being to survive. It is widely necessary for Homes, Industries for establishing electrical circuit.

Dijkstra's Algorithm

1. From the electrical circuit identify the source of electrical current set as the starting vertex.
2. Identify the shortest current flow neighbor nodes in the electrical circuit and check it is not visited
3. for each u in v
   if (distance[u]<distance[u]+adjacent[u][v])
   update distance add to shortest path
4. repeat step 2 and 3 until all node are visited.

The figure 4 show the shortest path for establishing electrical circuits connection using mesh equation and Cramer's rule.

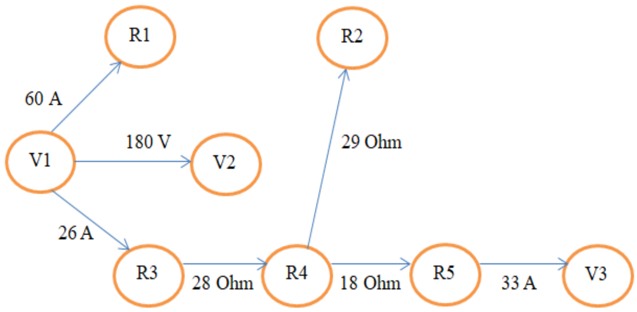

Fig 4 .Shortest path Mesh Circuit using Dijsktra's Algorithm

V. CONCLUSION

The essential favorable position of mesh current investigation is that it, for the most part, considers the arrangement of a vast system with less obscure qualities and less synchronous conditions. Our model issue address three conditions to comprehend the branch current strategy utilizing the Mesh current technique. This preferred standpoint is a lot more prominent as systems increment in unpredictability. It is utilized to unravel the planar circuits for the flow of current wherever in the electric circuits. As per the mess examination, we utilized Kirchhoff's law to touch base at an arrangement of equations which plans to compute the current. Therefore our requirement for high power can be accomplished both locally and mechanically.

In future we can apply this process, so we won't languish over the inadequate present as days passes and furthermore the expense of segments is decreased because of the quantity of decrease in the parts utilized. At whatever point we have like any condos or the packed zone, the entry of current may not be dynamic. So as to beat such disasters throughout our life, we can utilize the Dijkstra's calculation technique for the use of flows, and afterward, the dynamic flows might be ignored every one of the lofts or swarmed zone all the while.

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