Three Phase Load Balancing in an Indian Village using Blynk Application

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Abstract - *In India, Madhya Pradesh Paschim Kshetra Vidyut Vitran, District – Dhar, Tehsil – Manawar, Singhana Village Dedali B, has three phases of unbalance load difficulties. Overloading on phases, voltage fluctuations, unequal load sharing in each phase, and other factors may cause damage to household equipment and pose a safety risk. Because of a malfunction in the distribution system, some places are heavily laden while others are lightly loaded. Because the heavy laden phase utilizes more energy, clients' electricity bills will rise. An autonomous three-phase load balancing system was designed in this town to address these issues caused by load unbalancing. When unbalance develops, the suggested automatic load balancing system evenly distributes the loads in each phase. The current sensor, relay, and Arduino Nano were used to create this automatic three-phase load balancing system. We have also used the Blynk application for consumers in this suggested system so that they may monitor data, save it, and access it at any time and from anywhere. The proposed system's output demonstrates that the Arduino Nano and relays are successful in eliminating three-phase imbalance.*

Key words*: Blynk Application, Electricity bills, Arduino Nano, Load sharing, etc.*

1. INTRODUCTION

Electricity is a valuable source of energy, and its demand is growing by the day. It is quite important in today's society. All electrical energy is divided into three phases: generation, transmission, and distribution. After the electrical energy has been sent to the sub-system, the following step is to distribute it to all of the consumers. When a distribution system malfunction occurs, certain areas will be overloaded while others will be under loaded. To avoid these situations, load balancing techniques are required [1]. Due to unbalanced loads in the R, Y, and B phases, the current will flow in a neutral state. Increased unbalanced loads result in more current flow in the neutral point, which might pose safety issues and even fire [2].

Unbalancing of various load categories on a domestic level is a severe issue that causes line overload and high voltage unbalancing, resulting in serious damage to the applications. To address this problem, an effective load balancing mechanism is employed, in which a small number of loads are dynamically switched from overloaded lines to comparatively light load lines. The following are the causes of unbalanced loading:

1. Load increasing on single phase
2. Manually switching of phases from one phase to another
3. Fault on single phase
4. Unbalanced load on 3 phase
5. Unequal load sharing on phases

Consumer bills are calculated using tariffs in Madhya Pradesh Paschim Kshetra Vidyut Vitran, District –Dhar, Tehsil –Manawar, Singhana Village Dedali B, and they have several energy meters linked to their residence. Consumers may see an increase in their electricity bill as a result of the price increase on loaded meters. The fully charged energy meter consumes more units than the lightly charged energy meter. As a result, energy conservation is required, which can be accomplished through the use of the load balancing approach. In this work, a three-phase load balancing technique combining microcontrollers, switching relays and the Blynk application is employed to balance three-phase loads. When overloading occurs, this strategy focuses on automatic load balancing and shifting/sharing of loads between phases. We are employing the blynk application for consumers in this paper so that they can monitor the automated system from anywhere at any time. The load is automatically shifted via relays, which feed all three lines with power. In this proposed approach, the energy utilized on each line will be the same at the end of the month [3, 4].

2. LITERATURE SURVEY

1. Sajjaad Durrani, Hussnain Arif, Ehtisham Ali, Asad Ali, Shahid khan, Hazrat Ali, "A Smart Framework for power Distribution and Load Balancing using Arduino". The load automation built on arduino is highlighted in this paper. The suggested model in this work offers two crucial features: dependability and accuracy, as well as cost-effective alternatives to conventional PLC and SCADA-based solutions.

2. Mrs. S.S. Kumbar, Shrikant Biradar, Akshay Thalkari and Sanket Jadhav, "Three Phase Load Balancing". This study delves into load balancing in depth, as well as the stages involved in designing and implementing it in power distribution.

3. Faizan Rashid,Raza Ahmed, Hafiz Muhammad Talha,Arslan Khalid, "Dynamic Load Sharing at Domestic Level Using the Internet of Things". An automatic load management system is created in this study to balance the load by shifting it from one line to another.

3. OBJECTIVES:

There are some objectives of proposed work which are as follows:

1. Our project's major goal is to create an automatic load management system that can track and balance the load in three phases.

2. During load unbalancing, this project will assist consumers in shifting the burden from one phase to another.

3. Using the Blynk application, consumers can effortlessly watch, read, and record the automated system from anywhere at any time.

4. METHODOLOGY:

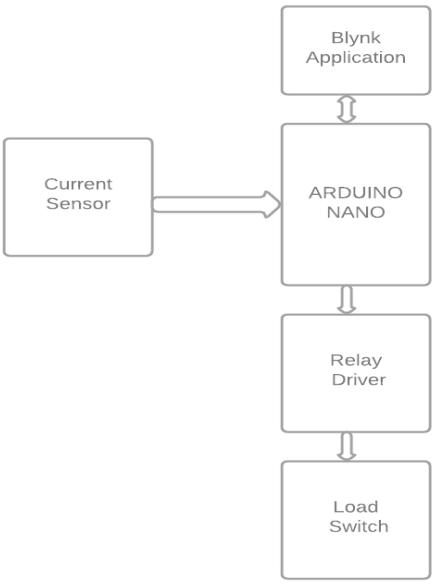

Fig 1: Block Diagram of proposed system

4.1 Blynk Application:

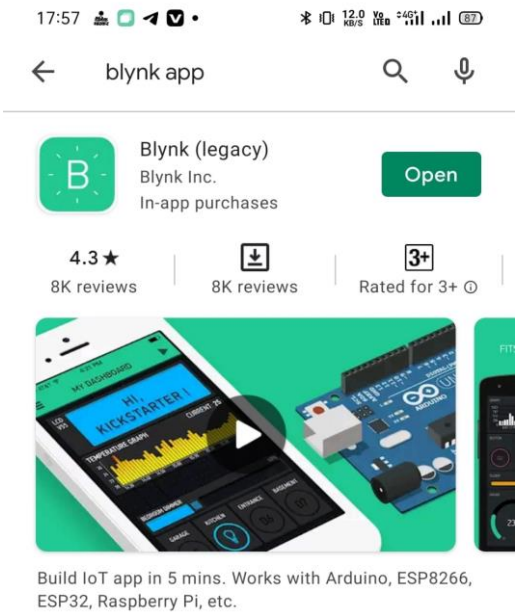

Fig 2: Blynk Application

Blynk is an internet of things (IoT) platform. This platform is capable of controlling Raspberry Pi, Arduino, NodeMCU, and other devices. We're utilizing Blynk with an Arduino Nano. It has the capability of controlling equipment, storing data, and displaying sensor data. We may also visualize the stored data

using the blynk App. This platform has three primary components.

1. **Blynk App:** It enables the creation of project interfaces using various widgets.
2. **Blynk Server**: It facilitates connection between the smart phone and the hardware. For connection between a smart phone and hardware, you can use Blynk cloud or a local Blynk server. For connection between our phone and the Arduino Nano, we're utilizing blynk cloud.
3. **Blynk libraries**: It facilitates communication with the Blynk cloud or a local Blynk server, as well as the processing of all commands, both outgoing and incoming.

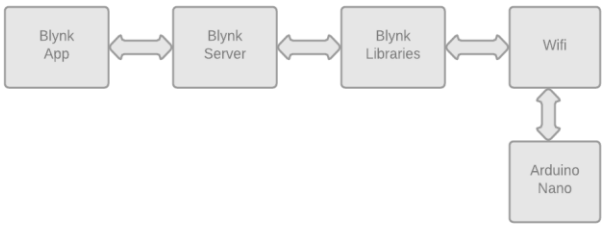

Fig 3: Flow chart representing the data transfer from Application to Microcontroller (Arduino Nano)

4.2 Arduino Nano:

Arduino Nano, like Arduino Uno and Arduino Mega, is a microcontroller board. Although the Arduino Nano is a little board, it has a wide range of applications. In this project, we're using an Arduino Nano because:

- It has 5V operating voltage.
- It has 14 digital pins.
- It has 7g weight .
- It has 19 mA power consumption.

4.3 Current Sensor:

The ACS712 is a current sensor that measures and calculates the amount of current flowing through a circuit. It's a fully integrated linear sensor IC based on the Hall Effect that can work in both DC and AC. In our circuit, we use an ACS712ELCTR-20A-T current sensor. This sensor module can detect current flows of up to 20A and may be read using an Arduino Nano's analogue I/O interface. The Arduino Nano offers a few more features, like as

- Its supply voltage ranges from 4.5 to 5.5 volts DC.
- It has a current range of -20A to 20A and a sensitivity of 100mV/A.

4.4 Relays:

A relay is a programmable electrically actuated switch that may be controlled with an Arduino or other microcontroller. It is used to turn on or off equipment, as well as to allow or disallow current flow. It serves as a link between Arduino and gadgets. As a switching device, we employed Single Pole Double through (SPDT) relays in our design. These SPDT relays are set up in a cascade configuration, allowing any load to be fed to any phase. Each of the three relays controls a single load or a group of lesser loads.

5. SIMULATION RESULTS AND DISCUSSIONS:

The proposed circuit diagram is designed using the Proteus software. In Proteus, we developed a three-phase load balancing system and analyzed the results, which are presented in fig. 5. Proteus software allows for the modeling of three-phase load balancing. In Proteus, the ACS712 current sensors are linked in series with the phase load through which the current will pass. The ACS712 current sensor is powered by a 5V battery. Over 3 phase load unbalancing is made much easier with this Proteus simulation architecture. To begin, the Arduino Nano delivers a signal to the relays, which unbalance the system, which is then balanced by evenly spreading load between phases.

Because phase L1 is only for static loads, Arduino Nano only monitors phases L2 and L3. When L2 and L3 are unbalanced, the Arduino Nano uses a three-phase load balancing method to try to balance the load by evenly dividing the load, and the ammeter findings are displayed on the Arduino Nano's LCD as well as in our Blynk application. Figure 6 also displays the results from the Blynk application before and after balancing. The blynk application is used for monitoring. It is a free programme that allows the user to monitor their power usage and units, as well as lower their power consumption when necessary. The graphical plots of

currents and power consumption for each phase before and after balancing are shown in Figure 7. The Blynk results before and after the load balancing are also recorded in Table-1.

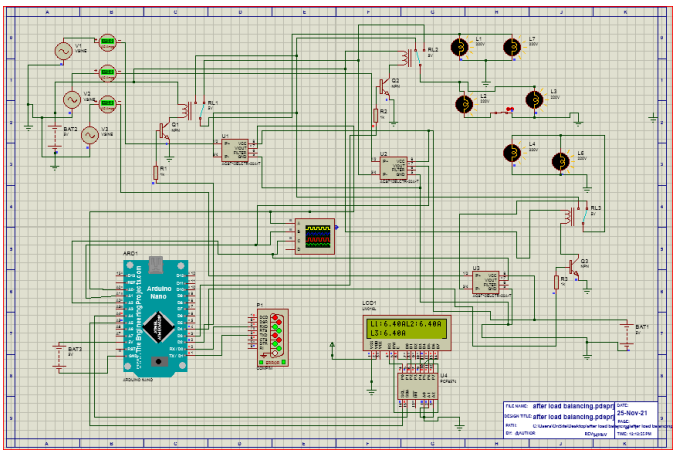

Fig 5: Circuit Diagram with 3 phase balanced load

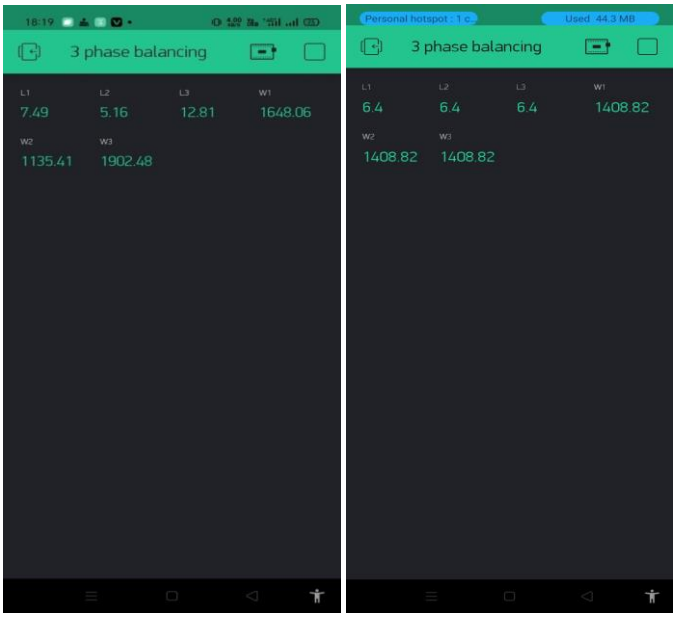

Fig 6: Results Obtained (Live) Before and After Three phase Load Balancing

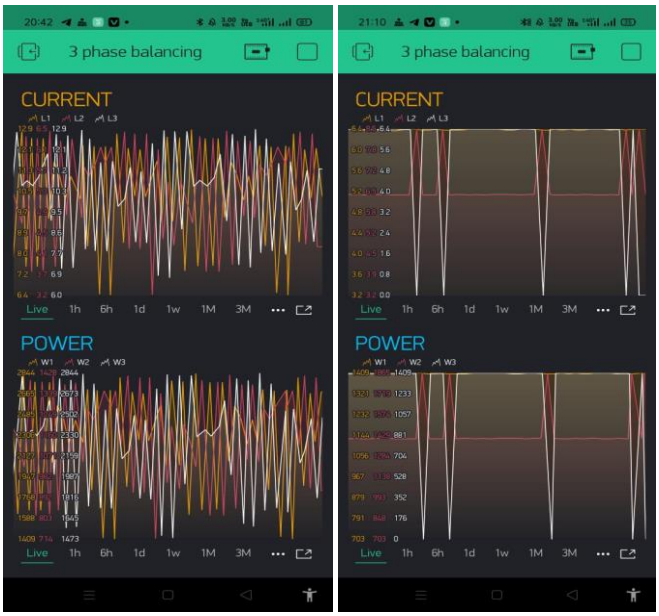

Fig 7: Graphical Results (Live) Before and After Three phase load balancing.

Table-1: Blynk Results

	Current			Power		
	L1	L2	L3	W1	W2	W3
Before balancing	7.49	5.16	12.81	1648.06	1135.41	1902.48
After balancing	6.4	6.4	6.4	1408.82	1408.82	1408.82

6. CONCLUSION:

The load unbalancing on phase causes the three phase unbalancing problem. An automatic three-phase load balancing system is required to solve this unbalanced condition. Proteus software is used to model this system. In this system, load can be equally shared on phases and due to this overload situation, energy losses and neutral current is reduced. The suggested system's simulation results show that the arduino nano and relays are successful in decreasing three-phase load unbalancing. In addition, we used the Blynk app for smart monitoring. This similar prototype can be employed in smart grids, and this work can also be used for more than three lines in the future.

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