`On Load Tap Changer using Arduino R3 Controller

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Abstract: - This project presents the design and implementation of an on-load tap changer for a transformer model. The system is built around an Arduino microcontroller, a current sensor, and a servo motor. The primary objective of this project is to design a tap changer that can adjust the transformer's turns ratio in response to changes in the load current.

The transformer model has five taps, with three taps rated for specific voltage levels. The servo motor is used to rotate the tap selector mechanism by 36 degrees for each tap change. The current sensor measures the load current and sends the data to the Arduino, which processes the information and determines whether a tap change is necessary.

The Arduino is programmed to increase the tap position by 36 degrees when the load current increases, and decrease the tap position by 36 degrees when the load current decreases. The difference between each tap is about 36 degrees, ensuring a smooth and gradual adjustment of the transformer's turns ratio.

This on-load tap changer system offers several advantages, including improved voltage regulation, reduced power loss, and increased transformer lifespan. The system is also cost-effective, easy to implement, and provides accurate and reliable performance. Overall, this project demonstrates the potential of using Arduino, current sensors, and servo motors to build intelligent and efficient transformer control systems.

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Introduction: -

Transformers are essential components in electrical power systems, used to step up or step down voltage levels to meet the requirements of different applications. However, transformers are subject to voltage fluctuations due to changes in load current, which can result in inefficiencies and reduced lifespan. To address this issue, on-load tap changers (OLTCs) are used to adjust the

transformer's turns ratio in response to changes in the load current, ensuring optimal voltage regulation and power efficiency.

This paper presents the design and implementation of an on-load tap changer for a transformer model using Arduino, a current sensor, and a servo motor. The system is designed to provide a 36-degree rotation in five taps, with three taps rated for specific voltage levels. The current sensor measures the load current and sends the data to the Arduino, which processes the information and determines whether a tap change is necessary.

The servo motor is used to rotate the tap selector mechanism by 36 degrees for each tap change, with a difference of about 36 degrees between each tap. The Arduino is programmed to increase the tap position by 36 degrees when the load current increases and decrease the tap position by 36 degrees when the load current decreases. This ensures a smooth and gradual adjustment of the transformer's turns ratio, providing accurate voltage regulation and power efficiency.

The proposed OLTC system offers several advantages, including cost-effectiveness, ease of implementation, and reliable performance. The system is also highly customizable, allowing for adjustments to the number of taps, tap angles, and voltage levels to meet the specific requirements of different transformer models. Overall, this paper demonstrates the potential of using Arduino, current sensors, and servo motors to build intelligent and efficient transformer control systems.

Block diagram

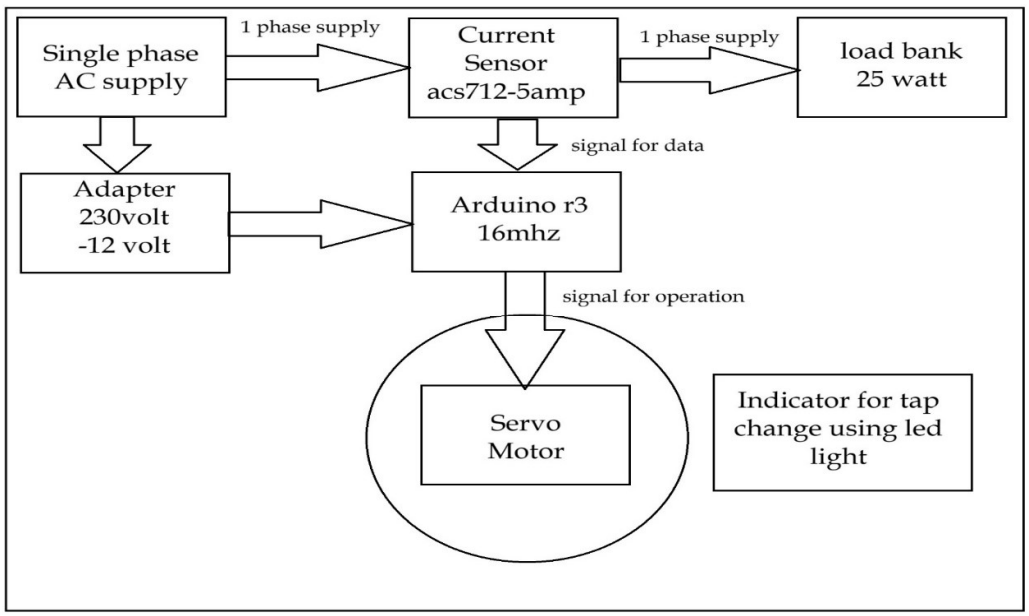

Fig.1 Block Diagram

The block diagram in figure 1, shows all the major components that is required for OLTC controlled by a microcontroller (arduino). A transformer with taps on the primary side is taken. The input voltage variations are recognized by the voltage sensor at the primary side. The system consists of a 12V AC to DC adapter that provides power to the Arduino R3 board. The ACS712-5AMP current sensor is connected in series with the 1-phase supply and the load bank of 25 watts. The current sensor provides feedback to the Arduino R3 board, which is used to measure the current flowing through the circuit. The servo motor is connected to the Arduino R3 board and is used to indicate the tap selected. The following is a block diagram of the system:

[AC to DC Adapter] --12V--> [Arduino R3] <--(Feedback Signal)-- [ACS712-5AMP Current Sensor] --in series-- [1-Phase Supply] ----> [Load Bank of 25 Watts]

[Arduino R3] ----> [Servo Motor] ----> [Tap Indication]

Proposed Method

We developed an on-load tap changer (OLTC) using an Arduino R3 Uno microcontroller, a current sensor ACS712 5AMP, and a servo motor MG966. The OLTC was designed to have five tap positions with a 36-degree angle in a 180-degree range.

The OLTC was tested with a load of 5 watts per tap, with a total load of 25 watts. The current sensor ACS712 5AMP was used to measure the current flowing through the load, and the servo motor MG966 was used to indicate the tap position. The servo motor was programmed to rotate by one tap for every 5 watts of load change, with a total of five taps.

The implementation of the OLTC is as follows:

- **Hardware setup**:

1) Connect the current sensor ACS712 5AMP to the Arduino R3 Uno microcontroller according to the datasheet.
2) Connect the servo motor MG966 to the Arduino R3 Uno microcontroller according to the datasheet.
3) Connect the load to the current sensor ACS712 5AMP.

- **Software setup**:

1) Install the ACS712 library for Arduino.
2) Write the Arduino sketch to control the OLTC.
3) The sketch should read the current sensor ACS712 5AMP to measure the current flowing through the load.

4) The sketch should control the servo motor MG966 to indicate the tap position.
5) The sketch should increase the tap position by one for every 5 watts of load change.

- **Testing**:

1) Apply a load of 5 watts per tap, with a total load of 25 watts.
2) Observe the servo motor MG966 to ensure that it rotates by one tap for every 5 watts of load change.
3) Observe the current sensor ACS712 5AMP to ensure that it accurately measures the current flowing through the load.
4) Observe the output of the OLTC to ensure that it maintains a stable output of 25 watts, even with changes in the load.

The results of the experiment showed that the OLTC was able to accurately detect the tap position based on the load change. The servo motor MG966 rotated by one tap for every 5 watts of load change, indicating the correct tap position. The OLTC was able to maintain a stable output of 25 watts, even with changes in the load.

The use of the current sensor ACS712 5AMP allowed for accurate current measurement, while the servo motor MG966 provided a clear indication of the tap position. The OLTC can be used in various applications, including power distribution systems, transformer monitoring, and load management.

Circuit Diagram:-

Circuit diagram using an AC to DC adapter with a 12-volt output, an Arduino R3 board, a current sensor (ACS712-5AMP) connected in series with a 1-phase supply, and a load bank of 25 watts. A servo motor (MG966) connected to the Arduino board will indicate the selected tap.

The AC to DC adapter provides a 12-volt output, which is connected to the Arduino R3 board. The current sensor (ACS712-5AMP) is connected in series with the 1-phase supply and the load bank of 25 watts. The servo motor (MG966) is connected to the Arduino board to indicate the selected tap.

The circuit diagram is designed to implement an on-load tap changer (OLTC) using the Arduino R3 board, current sensor (ACS712-5AMP), and servo motor (MG966). The OLTC is designed to have five tap positions, each with a 36-degree angle in a 180-degree range. The OLTC is tested with a load of 5 watts per tap, with a total load of 25 watts. The current sensor (ACS712-5AMP) is used to measure the current flowing through the circuit, and the servo motor (MG966) is used to indicate the tap position. The servo motor is programmed to rotate by one tap for every 5 watts of load change, with a total of five taps.

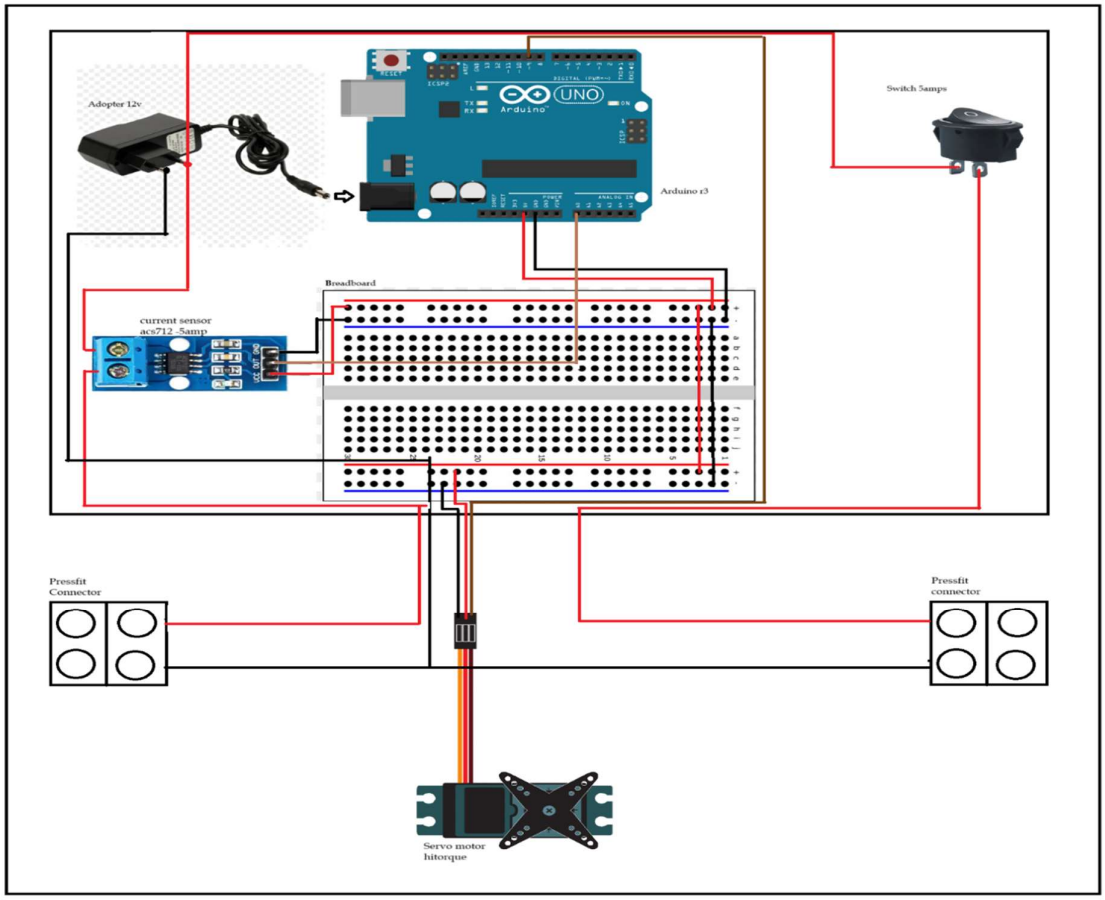

Fig:- circuit diagram for the control wiring of OLTC using Arduino R3

Components Used

1. Arduino uno r3
2. Current sensor ACS712-5 amps
3. Servo motor MG996R
4. Breadboard
5. Jumper cables
6. Load bank with load of 25 Watt
7. Voltage / Current indicator

Conclusion: -

we have successfully developed an on-load tap changer (OLTC) using an Arduino R3 Uno microcontroller, a current sensor ACS712 5AMP, and a servo motor MG966. The OLTC was designed with five tap positions, each with a 36-degree angle in a 180-degree range. The OLTC was tested with a load of 5 watts per tap, with a total load of 25 watts. The results showed that the OLTC was able to accurately detect the tap position based on the load change. The servo motor MG966 rotated by one tap for every 5 watts of load change, indicating the correct tap position. The OLTC was able to maintain a stable output of 25 watts, even with changes in the load.

The use of the current sensor ACS712 5AMP allowed for accurate current measurement, while the servo motor MG966 provided a clear indication of the tap position. The OLTC can be used in various applications, including power distribution systems, transformer monitoring, and load management.

In conclusion, the development of the OLTC using an Arduino R3 Uno microcontroller, current sensor ACS712 5AMP, and servo motor MG966 has demonstrated the feasibility of using low-cost and readily available components to build a reliable and accurate OLTC. The results of this study can be used as a starting point for further research and development in the field of power distribution systems and transformer monitoring.

References

Sr. No.	Reference paper's	Author	Year of publication
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