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WIRELESS CONTROL AND HARDWARE DESIGN OF SINGLE PHASE SEMI CONTROL RECTIFIER FOR DC SHUNT MOTOR

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Abstract - *This work is carried out with the analysis of speed control of dc shunt motor [1]. We have used semi-controlled rectifier. We are using wireless facilities like Bluetooth, Wi-Fi, GSM module as the wireless communication [2]. Reducing power loss in converter is the part of our motto. The research work is carried with the single phase rectifier. Here we have shown the uncontrolled and controlled circuit of single phase rectifier. By varying the firing angle, we can change the average output voltage which is fed to DC shunt motor. SCRs are used along with the diodes to form the rectifier circuit. Arduino has the role of providing firing pulses to the SCRs [5]. ZCD is used to maintain the synchronism between firing pulses and AC supply [3].*

Key Words: SCR, ARDUINO, WIRELESS, DC MOTOR, SPEED CONTROL, RECTIFIER

1. INTRODUCTION

Nowadays motors are used almost everywhere, so to control them is really essential task. Energy conservation is the biggest issue through the world. There are numbers of debates going on around the globe as how to save electrical energy. Efficient utilization of energy is the one of the most prominent solution. In a power conversion process the main task is to minimize energy losses and maximize the conversion efficiency. The need of variable dc power supply in power electronics is because of industry`s huge requirement. Rapid improvement in this world has introduced us to latest technology which we can use to modify existing equipment to make human life better. Problem of time management in this era is not new. To solve it in electric engineer`s life we can improve available devices to control them from anywhere anytime.

The main objectives of the work carried out are:

1. To study and analysis of semi-controlled single phase rectifier.
2. How we can use latest technologies to improve utilization of devices or equipment
3. To utilize ZCD for synchronism.

2. BLOCK DIAGRAM

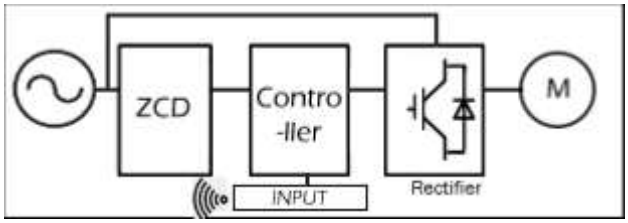

Fig -1**:** Basic block diagram of semi-controlled rectifier

Figure.1 is the block diagram of our system. Here first unit is Zero Crossing Detector, where we can get high output when there will positive cycle come, and low when there will be negative cycle. The second unit is controller (Arduino in our case) which will provide firing pulse, will take and give speed data, and will measure speed. Here third unit is semi-controlled rectifier which will convert AC supply in to pulsative DC with variable amplitude. This will be filtered with the help of smoothing capacitor. By changing alpha (firing angle) we can change the output voltage. We have used DC shunt motor as a load.

3. SIMULATION ANALYSIS AND RESULTS

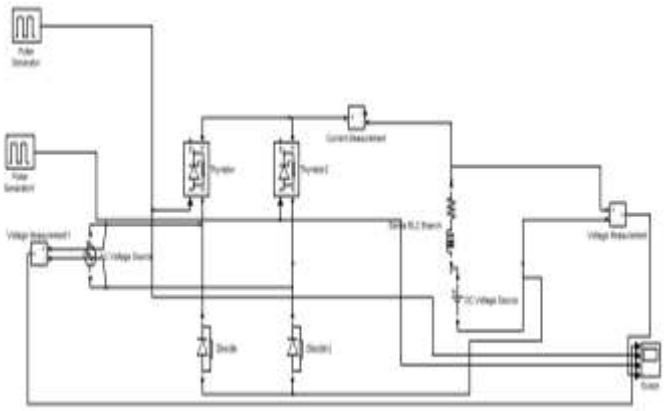

Fig -2: Single phase semi controlled rectifier

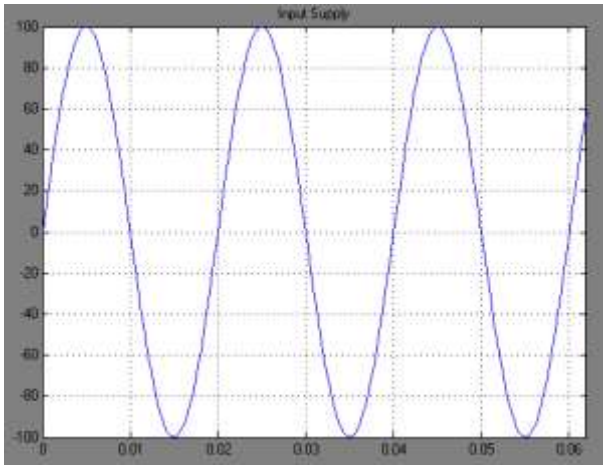

Fig -3: Input Supply Voltage

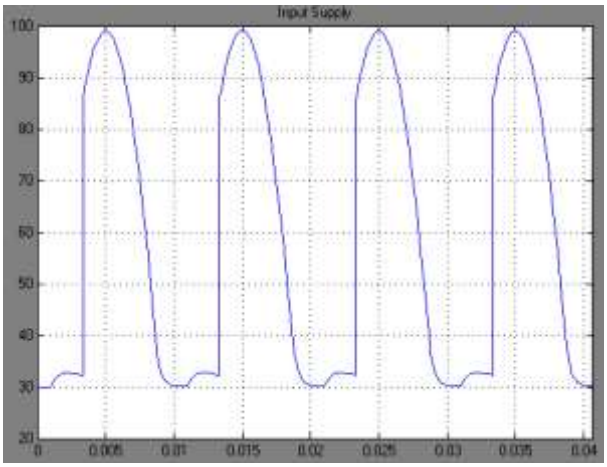

Fig -4: Output Voltage

Here we have simulated single phase semi-controlled rectifier where we have given 70.72 V ac supply and phase angle control technique is used. We are comparing sine wave with ground and generated signal is given to Arduino. Here two SCR and two diodes are making rectifier circuit, which convert ac supply into dc supply (shown in figure. 3, 4 simulation result).

4. HARDWARE COMPONENTS

COMPONENT SPECIFICATION			
Sr.No	Component	Name/ Number	Rating
1	Permanent Magnet DC Motor	775	0-36v 14 A
2	Diode	1N5402	1000v 3 A
3	SCR	TYN612	1000v 12 A
4	Arduino	Uno	NA
5	IR Sensor	NA	NA
6	OP-Amp	Lm358	3-12v
7	Bluetooth Module	HC-05	NA
8	Transformer	Step-Down	12-0-12

5. HARDWARE MODEL

Fig -5: Working Model

Fig -6: Output Waveform of R Load

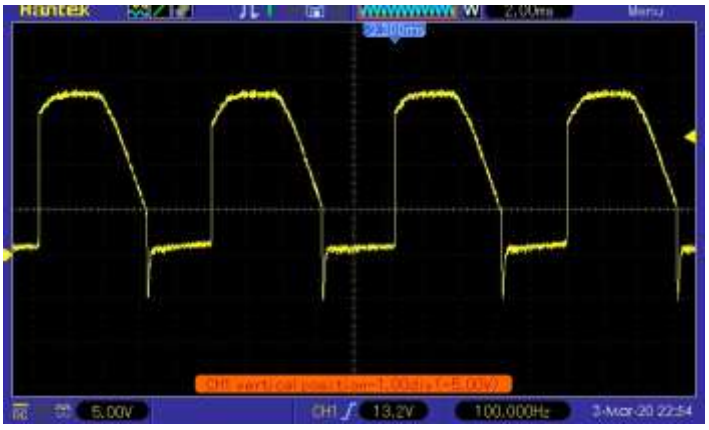

Fig -7: Output Waveform of R-L Load

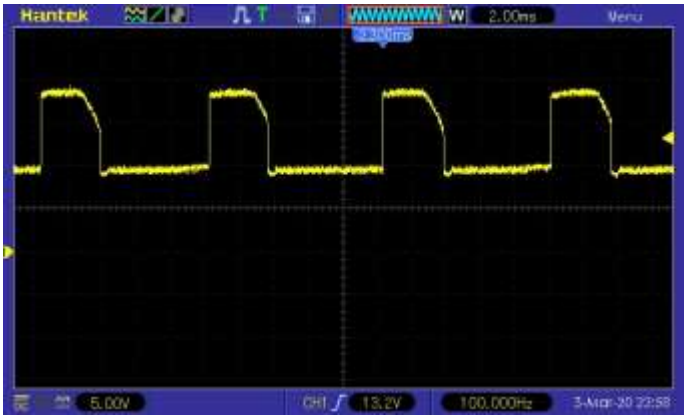

Fig -8: Output Waveform of R-E Load

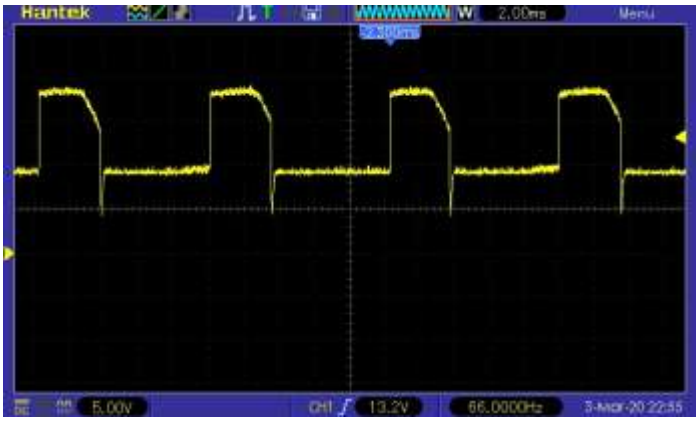

Fig -9: Output Waveform of R-L-E Load

The analysis of conventional single phase semi-controlled rectifier is done in the traditional method. Capacitor is connected in parallel for removing fluctuation from the dc bus voltage (not in DSO waveforms). Diodes are used because we would get the same result by using four SCRs which will result in more power loss since gate current will produce some losses. Both SCRs are triggered by Arduino. By entering the value via serial port (wired or wirelessly) the Arduino will change the firing angle according to the current speed. If the speed is more than the desired value, the firing angle will rise and vice versa. As the speed feedback we have used an IR Sensor which will make its pin high after each rotation. By adding its high time value and low time value we can get current speed which is done by Arduino.

So here we have given 12 V ac to the rectifier unit which can convert it into 0- 17v D.C. This 0-17 V dc is output of our rectifier unit as well as input of our DC shunt motor unit, which will rotate at certain speed according to its input voltage. Here we have added HC-05 (Bluetooth module) which gives us facility to send data wirelessly via mobile [4], so we can change motor`s speed through our mobile. We do not even have to go near to the control circuit this can be expand by using available wireless communication modules like ESP32 (Wi-Fi module), GSM module etc.

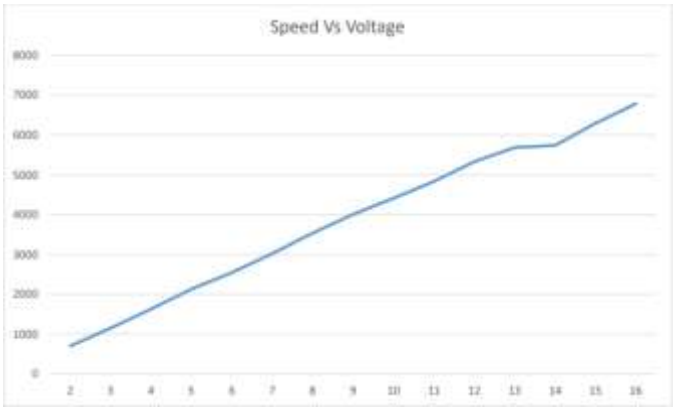

Chart -1: Speed vs Voltage

6. CONCLUSIONS

Generally, there are different control strategies to operate motor. With the utilization of power electronics, we can convert the AC/DC power at controllable mode. And for this controlling we uses different power electronics devices such as SCRs, diodes. Nowadays, we are going to use a wireless controlling feature in the converter. On the other hand, this converter can also be used as the variable DC source with advanced feature. By just changing the SCRs and diodes (as per load ratings) we can use this converter for any DC Shunt motor.

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