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Optimized Position and Angle Tracking of Windmill System Using Arduino Joystick

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Abstract: In this paper, a new optimized position and angle tracking of wind mill system using smart phone app called arduino joystick, is investigated to increase the output of wind mill system by tracking direction of the wind and turn the rotor part according to the maximum wind density by arduino joystick. This System presents the development of an experimental Prototype of an emulator for wind turbines, with controllers based on android communication networks. Most of the wind mill position is in stationary or fixed direction. But the density of the air is not good enough in particular directions and it's based on the environmental cyclic period process. So that most of the wind mills are not working continuously in all the days. The application of the android network in this system focuses on the maximum wind density direction and rotor is adjusted according to the wind density to obtain maximum power production of wind mill.
Keywords: optimized position, angle tracking, smart phone application, maximum wind density, environmental cyclic period, maximum power point tracking.

I. INTRODUCTION

Wind power is a free, renewable, clean energy source. It produces no greenhouse gases or pollution, and uses no water in the generating process, unlike other power sources. Turbines have relatively low maintenance costs. The wind Energy is the most popular power harvesting system under renewable sources.[14]-[16]-[18]-[20] The position of the wind mill system has fixed direction based on regional air density calculation. This type of installation is so cost and less power generation. A wind turbine transforms the mechanical energy of wind into electrical energy. A turbine takes the kinetic energy of a moving fluid, air in this case, and converts it to a rotary motion.[1] As wind moves past the blades of a wind turbine, it moves or rotates the blades. These blades turn a generator and the generator is rotated in the maximum speed and produce electricity. This electricity is collected and used for multiple purposes. Electricity generated from a wind farm will travel to a transmission substation, where it is stepped up to a high voltage in the region of 150-800 kV. It is then distributed along the electricity grid power lines to the consumer. The main purpose of the windmill is to convert wind energy into electrical energy. These obtained electrical energy is used for multiple purposes. William Kamkwamba (born August 5, 1987) is a Malawian inventor, who invited the windmill system. He built a wind turbine to power multiple electrical appliances in his family's house in Wimbe, 32 km (20 mi) east of Kasungu, using blue gum trees, bicycle parts, and materials collected in a local scrapyard. Never days, wind turbines are predominantly made of steel (66-79% of total turbine mass); fiberglass, resin or plastic (11-16%); iron or cast iron (5-17%); copper (1%); and aluminum (0-2%). The stiffness of composites is determined by the stiffness of fibers and their volume content. Typically, E-glass fibers are used as main reinforcement in the composites. Typically, the glass/epoxy composites for wind turbine blades contain up to 75% glass by weight. This increases the stiffness, tensile and compression strength. A promising composite material is glass fiber with modified compositions like S-glass, R-glass etc. Other glass fibers developed by Owens Corning are ECRGLAS, Advantix and Wind Strand. Carbon fiber has more tensile strength, higher stiffness and lower density than glass fiber. An ideal candidate for these properties is the spar cap, a structural element of a blade which experiences high tensile loading. A 100-metre (330 ft) glass fiber blade could weigh up to 50 tonnes (110,000 lb), while using carbon fiber in the spar saves 20% to 30% weight, about 15 tonnes (33,000 lb). However, because carbon fiber is ten times more expensive, glass fiber is still dominant. The best places for wind farms are in coastal areas, at the tops of rounded hills, open plains and gaps in mountains - places where the wind is strong and reliable. Some are offshore. Working of wind mill system is, When the wind strikes the rotor blades, blades start rotating. The turbine rotor is connected to a high-speed gearbox. Gearbox transforms the rotor rotation from low speed to high speed.[19]-[20] The high-speed shaft from the gearbox is coupled with the rotor of the generator and hence the electrical generator runs at a higher speed.

An exciter is needed to give the required excitation to the magnetic coil of the generator field system so that it can generate the required electricity. The generated voltage at output terminals of the alternator is proportional to both the speed and field flux of the alternator. The speed is governed by wind power which is out of control. Hence to maintain uniformity of the output power from the alternator, excitation must be controlled according to the availability of natural wind power. The exciter current is controlled by a turbine controller which senses the wind speed. Then output voltage of electrical generator (alternator) is given to a rectifier where the alternator output gets rectified to DC. Then this rectified DC output is given to line converter unit to convert it into stabilized AC output which is ultimately fed to either electrical transmission network or transmission grid with the help of step-up transformer. An extra unit is used to give the power to internal auxiliaries of wind turbine (like motor, battery etc.), this is called Internal Supply Unit. After storing power, it is used for multiple purposes. There are two types of locations where wind mill systems are used, they are Onshore – Wind turbines harness the energy of moving air to generate electricity.[4]-[7]-[13]-[15] Onshore wind refers to turbines located on land Offshore – offshore turbines are located out at sea or in freshwater. The **Muppandal** Wind Farm is India's largest operational onshore wind farm. This project located in Kanyakumari district, Tamil Nadu. The project was developed by Tamil Nadu Energy Development Agency. Its installed capacity is 1,500 MW, which makes it the **3rd-largest operational onshore** wind farm in the world. A general rule of thumb is to install a wind turbine on a tower with the bottom of the rotor blades at least 30 feet (9 meters) above any obstacle that is within 300 feet (90 meters) of the tower.

In the GE 1.5-megawatt model, the nacelle alone weighs more than 56 tons, the blade assembly weighs more than 36 tons, and the tower itself weighs about 71 tons — a total weight of 164 tons. Relatively small investments in increased tower height can yield very high rates of return in power production. The main aim of wind mill system is based on the density of air, the wind mills are installed according to the direction of the wind flow on the time of installation.[8]-[9]-[10]-[17] The main drawback of the existing wind mill system is windmills are installed based on the density of wind and its direction, on that particular cyclic period the direction of the wind flow will be in same direction for some weeks or months after that cyclic period the direction of the wind flow will change automatically therefore the windmill installed on that particular cyclic period will run for few days and stop generating electricity until the wind direction changes according to installed windmill direction.

In this paper, a new optimized position and angle tracking of wind mill system using smart phone app is investigated to increase the output of wind mill system by tracking direction of the wind and turn the turbine according to the maximum wind density using smart phone application. [11]-[12] Using this technology, we can generate electricity on any direction of the wind flow at any time by turning the turbine the smart phone against the wind flow direction. Therefore, using this technology, we can operate the stopped windmills due to the opposite direction of the wind flow.[5]-[3]-[2]-[6] By using this project, we can increase the output of windmills by tracking the wind mill to the maximum power point tracking. Whereas using this technology 100% of windmills will work at any direction of wind density.

II. PROPOSED SYSTEM OF WIND ENERGY

The proposed system of wind energy is optimized position and angle tracking of wind mill system using android application. This proposed system is investigated to increase the output of wind mill system by tracking direction of the wind and turn the turbine according to the maximum wind density using smart phone application. This System presents the development of an experimental Prototype of an emulator for wind turbines, with controllers based on android communication networks. The application of android networks in this system focuses on the maximum power point tracking system of a wind turbine, eliminating the wind speed sensing. The elimination of these sensors is aimed at reducing the problems related to the logistics of maintenance. The network receives as input the mechanical power of the rotor axis and the generator speed and provides as output the estimated wind speed. The analysis of the system is experimented in micro hardware model.

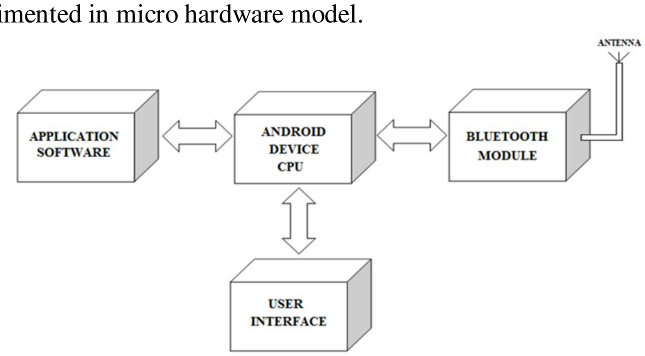

Fig 1.1 Wireless Communication Block Diagram

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Here we develop an Android Application for sending communicating with the hardware base station. The user controls and Bluetooth connectivity is designed for the application using "**Android SDK**" software tool. The application was developed in eclipse using java. This app enables the smart phone to connect to a Bluetooth modem via

Serial Port Profile (SPP). Software packages required include Java Development Kit (JDK), the Eclipse software environment, Android Development Tools (ADT) and Android SDK (Software Development Kit) An Android phone sends its command to the client Bluetooth-enabled devices through an embedded Bluetooth module. The phone is used as a host controller which establishes their communication with Bluetooth modules. The communication between the master and slave Bluetooth devices covers the processes of device power-up and data exchange whereas the protocol is established in the Bluetooth software stack. Bluetooth modem used here is HC-05 which is a Bluetooth Core V2.0 compliant module with SPP. The module is designed to be embedded in a host system which requires cable replacement function.

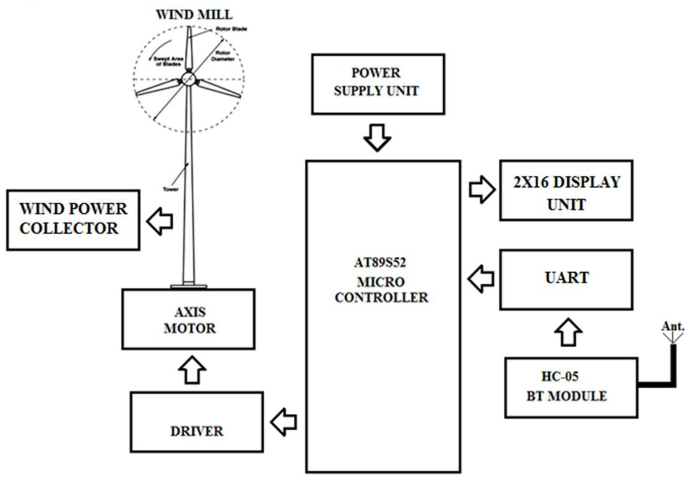

Fig 1.2 Hardware Block Diagram

Here we use NUVOTON MICROCONTROLLER AT89S52 it is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The AT89S52 provides features of 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, and three 16-bit timer/counters, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with software that supports two selectable power saving modes. Highly-flexible and cost-effective solution to embedded control applications. The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5V supply. Each receiver converts EIA-232 inputs to 5-V TTL/CMOS levels. It is used to data transfer between Bluetooth modem and microcontroller unit. The microcontroller receives the command from Bluetooth module through IC MAX232 and executes the corresponding predefined program to control the motor (high torque geared DC motor) through H-bridge driver (IC L293D). The wind turbine attached with the Motor and hence it is rotation. Special features of AT89S52 Microcontroller are SPECIAL FEATURES OF MICROCONTROLLER Compatible with MCS®-51 Products,128 x 8-bit Internal RAM,32 Programmable I/O Lines, Two 16-bit Timer/Counters, Low-power Idle and Power-down Modes, Interrupt Recovery from Power-down Mode, Watchdog Timer & Dual Data Pointer, Flexible ISP Programming (Byte and Page Mode). Direct, indirect and relative addressing modes, Power-On Reset (POR). Power-up Timer (PWRT) and Oscillator Start-up Timer (OST).

Here we use Bluetooth device named BLUETOOTH HC-05 It has a Default Baud rate of 38400, 8 Data bits, 1 Stop bit, has No parity, has data control Supported rate of 9600, 19200, 38400, 57600, 115200, 230, 400, 460800. If the device is given a rising pulse in PIO0, device will be disconnected. PIO10 and PIO11 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s. Auto-connect to the last device on power as default. The maximum range of this Bluetooth device is 200 meters (approx. 656 feet). It Permits paired devices to connect as default. Auto-pairing PINCODE:"0000" as default or can be modified as per our convenience. Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection. To program this technology, we use some software's like µ-vision 5, KEIL, ISP, ANDROID STUDIO. By using android studio software was developed app named ARDUINO JOYSTICK using this app the gear motor connected to the rotor is controlled. App is designed with four arrow mark which each arrow represents the particular directions like East, West, North, and South as shown in fig 1.5. Here only two directions are used such as North and South. Where only the two arrow marks are used for rotating the gear motor in forward and backward directions.

III. EXISTING SYSTEM

In the existing system of the windmill consist a stable wind turbine as shown in fig 1.3. The Wind turbines operate by transforming the kinetic energy in wind into mechanical power which is used to generate electricity by spinning a generator. These turbines can be on land, or can be offshore wind turbines. It consists of wind turbine, tower, gearbox, generator, rotor blades and nacelle. Wind-turbine consist of gear box, generator and rotor blades. Rotor Blades - The rotor blades of a wind turbine operate under the same principle as aircraft wings. One side of the blade is curved while the other is flat. The wind flows more quickly along the curved edge, creating a difference in pressure on either side of the blade. The blades are "pushed" by the air in order to equalize the pressure difference, causing the blades to turn. Nacelle – The nacelle contains a set of gears and a generator. The turning blades are linked to the generator by the gears. The gears convert the relatively slow blade rotation to the generator rotation speed of approximately 1500 rpm. The generator then converts the rotational energy from the blades into electrical energy. Tower – The blades and nacelle are mounted on top of a tower. The tower is constructed to hold the rotor blades off the ground and at an ideal wind speed. Towers are usually between 50-100 m above the surface of the ground or water. Offshore towers are generally fixed to the bottom of the water body, although research is ongoing to develop a tower that floats on the surface. Electric generators are used to transform mechanical or kinetic energy into electric potential difference, also known as voltage. There are several power generation applications that require the use of electric generators. The first electric generators created direct current (DC), but later were replaced with the cheaper, more efficient alternating current. Almost all power plants use (AC) generators; the exception is photovoltaic cells.

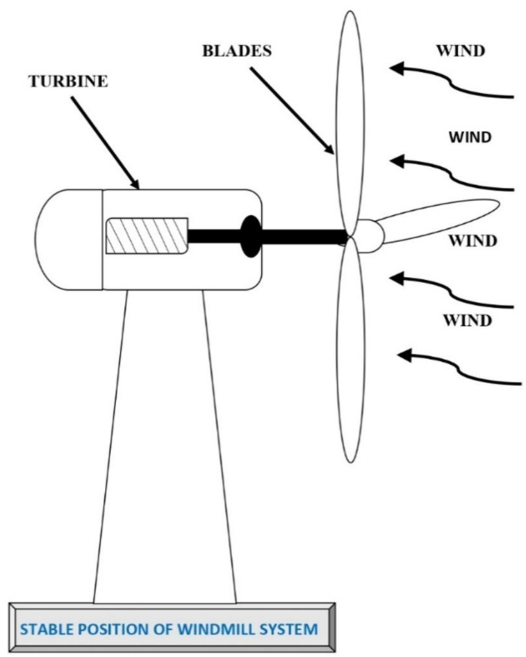

Fig 1.3 Stable Position of Windmill System

The windmill system is in stable position in this existing system as shown in the above diagram. This windmill system runs only when the wind flows according to the windmill installed position. The existing system of wind mill technology runs only in one direction of wind flow, if wind flows in different directions, it cannot able to produce Power during different direction of wind flow. These are the main draw backs of the existing wind mill system.

IV. RESULT AND OUTPUT

The modified wind mill system is constructed using the gear motor and smart phone application. The rotor part consisting (rotor, blades, generator) is turned using smart phone application. Using this technology, the wind mill system can be turned in 360^o of rotation or turned into any pole of the direction (north, south, east, and west) where the windmill system is turned/rotated to any direction of wind flow using the smart phone application with the help of Bluetooth communication system.

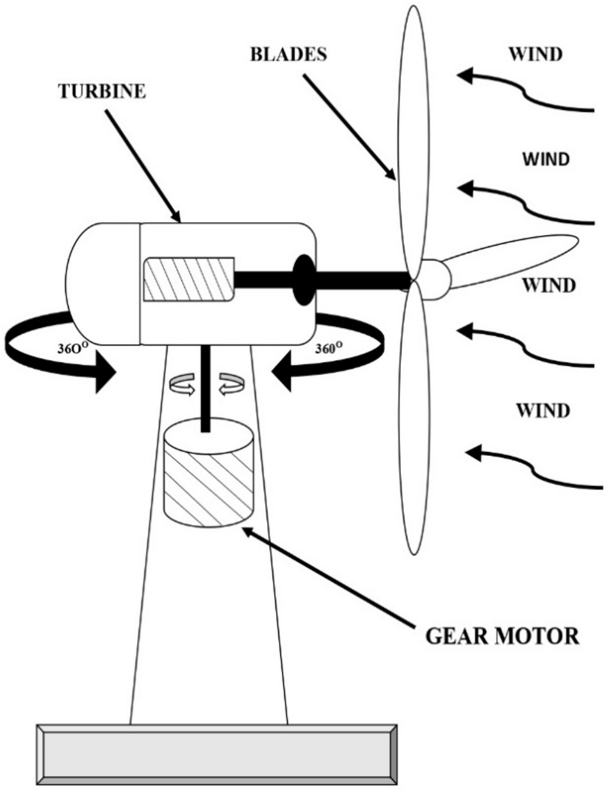

Fig 1.4 Turn Able Wind Mill System

Thus, the existing wind mills can be modified into this technology. Using this technology, the existing stable windmill systems can be converted into 360°
Turn able system using the smart phone application.

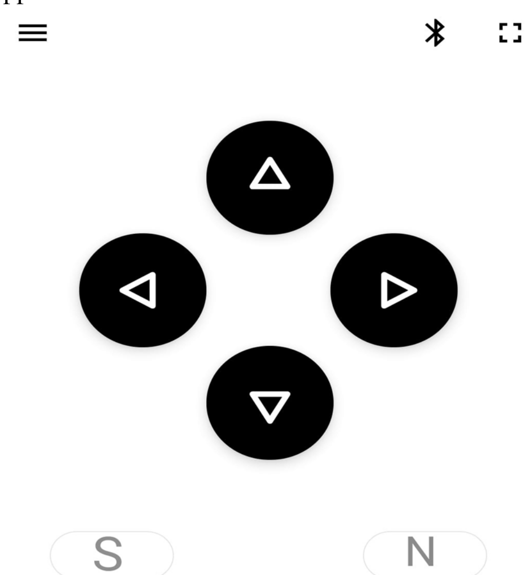

Fig 1.5 Arduino Joystick Page

Fig 1.5 indicates the arduino joystick app page which consist of a four arrows to control the gear motor in forward direction and reverse direction. Here only the two arrows are used for controlling the gear motor such as left arrow and right arrow. Left arrow indicates South direction and the right arrow indicates north direction.

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V. CONCLUSION

Thus, power production scheme has been proposed
With efficient optimized position and angle tracking of wind mill system using smart phone app. Bluetooth Input is connected to the microcontroller and one connection is taken from the microcontroller to driver to rotate the rotor part of the windmill. By rotating rotor part according to the wind density, the power production of the wind mill of proposed technology is higher than the existing static wind mills.

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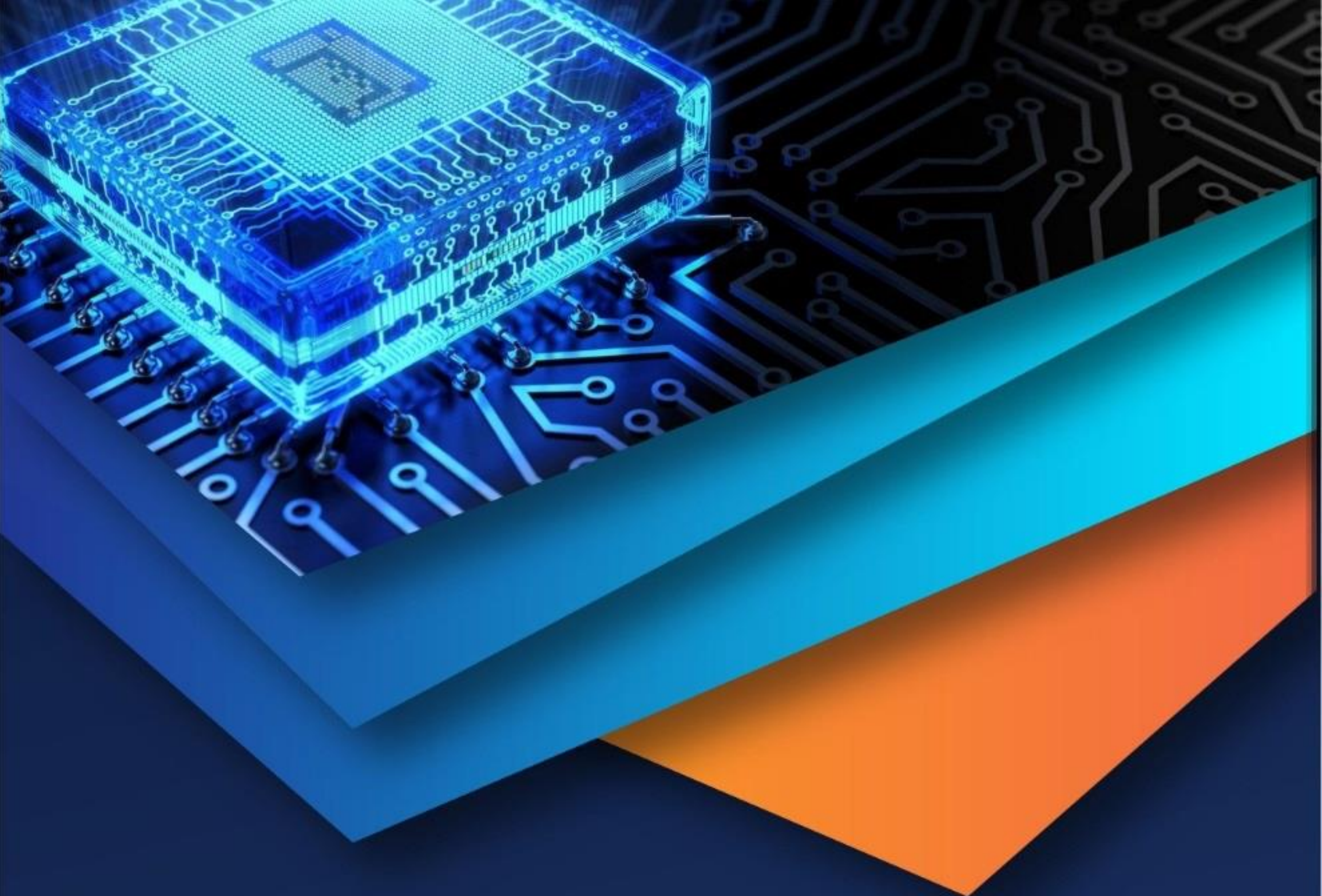

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