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Smart Regulator For Controlling Fan Speed Through Android Mobile

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ABSTRACT

In today's era of smart electronics, wireless control of home appliances has become essential for convenience and energy efficiency. This project presents a Bluetooth-based fan speed control system using an Arduino microcontroller, I2C LCD, Bluetooth module, motor driver, and a DC fan. The system allows users to control the speed of a fan remotely via a smartphone Bluetooth app. By receiving commands through the Bluetooth module (HC-05), the Arduino processes the input and adjusts the speed of the fan using PWM (Pulse Width Modulation) through the motor driver. The real-time speed level is displayed on the I2C LCD. This system offers a low-cost, flexible, and energy-efficient solution for smart fan control in homes and workplaces.

Keywords: Bluetooth, Fan, Speed Control.

I. INTRODUCTION

With the rise of Internet of Things (IoT) and wireless technologies, automation has found a prominent place in modern life. Traditional fan speed control mechanisms require manual operation through regulators. However, they are inconvenient and lack precision. In contrast, Bluetooth-based systems offer wireless convenience and accuracy. This project utilizes the Arduino microcontroller to control the speed of a DC fan using user input from a Bluetooth-connected mobile device. The LCD displays the fan speed level, and the motor driver ensures safe control of the fan's motor. This approach is not only user-friendly but also scalable to other appliances, forming the foundation for smart home systems.

1.1 Existing System

The current systems for fan control typically use rotary switches or electronic regulators that require physical interaction. Some modern systems use IR remote control, which is limited by line-of-sight requirements. Additionally, these systems often lack feedback or display for real-time fan speed status. There is limited integration with mobile devices in traditional setups.

1.2 Proposed System

The proposed system introduces a Bluetooth-controlled fan speed regulator using Arduino. It replaces traditional switches with wireless Bluetooth communication between a mobile device and an Arduino board. The system uses PWM to control the speed of a DC fan via a motor driver, with real-time speed level shown on an I2C LCD. This setup is compact, efficient, and suitable for smart home integration. The user simply opens a mobile app and sends speed commands via Bluetooth, and the Arduino interprets and executes these commands safely.

II. LITERATURE SURVEY

Patil, A., et al. (2017) - In "Bluetooth based Home Automation System using Arduino and Android Application", International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, the authors developed a system for controlling home appliances via Bluetooth using Arduino and Android. Their approach confirms the feasibility of low-cost wireless control using HC-05.

Mohana, S. & Ramesh, K. (2018) - In their paper "Smart Fan Speed Control using Wireless Technology", Journal of Emerging Technologies and Innovative Research, the authors emphasized the use of wireless technologies for controlling fan speed and the importance of using microcontrollers for precise PWM control.

Kumar, V. & Gupta, R. (2020) - Their study "Design and Implementation of a Smart Fan System Using IoT", in the International Journal of Scientific Research in Engineering and Management, demonstrated the real-world application of fan control using microcontrollers and mobile-based communication.

III. WORKING

The system works by connecting a smartphone to the HC-05 Bluetooth module. Once paired, the user sends a command such as "1", "2", or "3" to set the fan speed (low, medium, high). The Arduino receives this input via UART, interprets it, and generates the corresponding PWM signal. This signal is sent to the motor driver (L298N or similar), which then drives the DC fan accordingly. The current speed level is displayed on the I2C LCD for user confirmation.

3.1 METHODOLOGY

The project follows a modular approach:

Input: Bluetooth input from smartphone via HC-05

Processing: Arduino receives and decodes the command

Output: PWM signal to motor driver, real-time speed shown on LCD
This modular design allows for future expansion, such as adding sensors for temperature-based automatic speed control.

3.2 HARDWARE AND SOFTWARE DETAILS

Hardware:

Arduino Uno/Nano – Microcontroller for control logic

HC-05 Bluetooth module – Wireless communication

L298N Motor Driver – Controls speed of DC fan

DC Fan – Load to be controlled

I2C 16x2 LCD – To display speed level

Power Supply – 5V/12V regulated source

SOFTWARE:

Arduino IDE – For coding and uploading

Bluetooth Terminal App (e.g., Serial Bluetooth Terminal) – To send commands

Embedded C / Arduino Sketch – Programming language

3.3 COMPONENT DESCRIPTION

Arduino Uno: The heart of the system; handles logic and PWM generation.

HC-05 Bluetooth Module: Enables wireless communication between mobile phone and Arduino.

Motor Driver (L298N): Used to safely drive the DC fan and handle current.

DC Fan: The actual load; its speed is controlled by PWM.

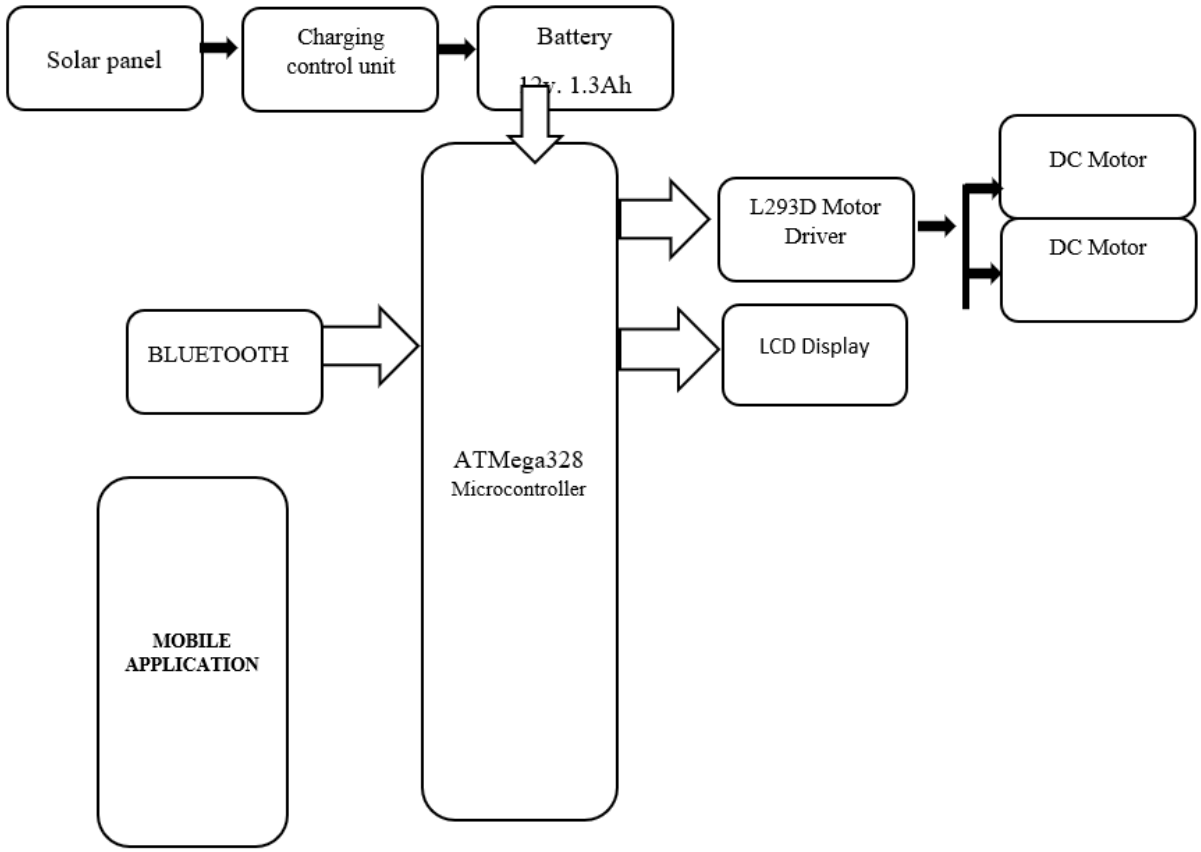
I2C LCD Display: Efficiently shows the current speed level without using many pins.

Power Supply: Provides necessary voltage and current for each module.

IV. SYSTEM OVERVIEW

The fig.1 shows block diagram which gives you the overview of the proposed system. The brief description given bellow.

2.2.1. BLOCK DIAGRAM DESCRIPTION:



V. MICROCONTROLLER

3.1 Introduction

To make a complete microcomputer system only micro controller is not sufficient, it is necessary to add other peripherals such as read only memory (ROM), read / write memory (RAM), decoders, drivers, latches, number of input / output devices to make a complete microcomputer system. In addition, special purpose devices, such as interrupt controller, programmable timers, programmable I/O devices, DMA controllers, USART/UART, programmable keyboard/display drivers may be added to improve the capability, performance and flexibility of a microcomputer system. In addition battery backup and an elaborate power supply arrangement is essential. However the key feature of micro controller based computer system is that, it is possible to design a system with a great flexibility. It is possible to configure a system as large or as small system by adding or removing suitable peripherals. On the other hand, the micro controller incorporates all the features that are found in micro controller. However, it has added features to make a complete microcomputer system on its own. Therefore the micro controllers are sometimes called as single chip microcomputer. The micro controller has built-in rom, ram, parallel I/O, serial I/O, counters, interrupts and a clock oscillator circuit.

Simplified block diagram of 8051 family microcontroller

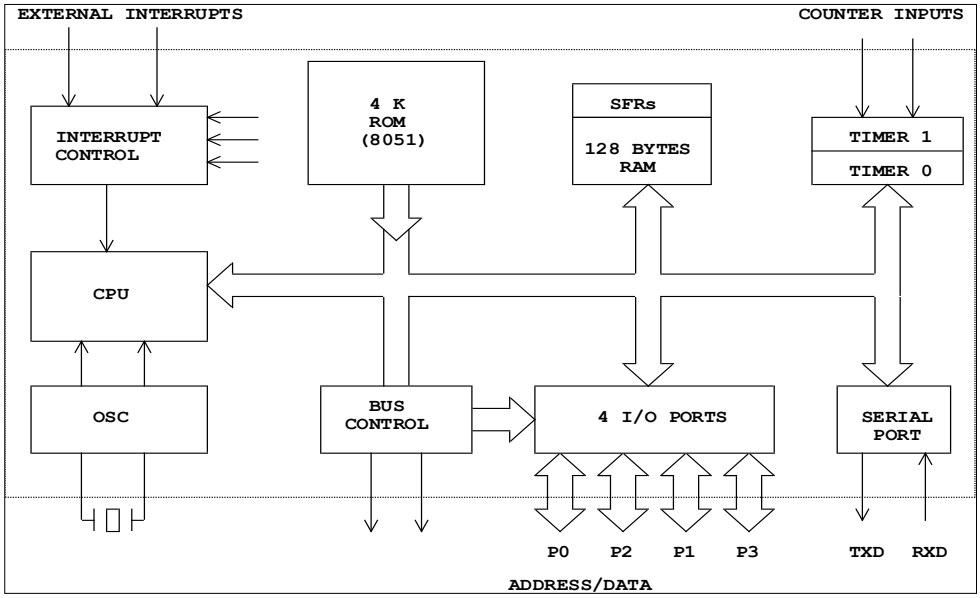


Figure 1: *Block diagram of 8051 family microcontroller*

As shown in the above figure the micro controller has on-chip (built-in) peripheral devices. These on chip peripherals make it possible to have single-chip microcomputer system.

3.3 Pin Description of ATmega328 Microcontroller:

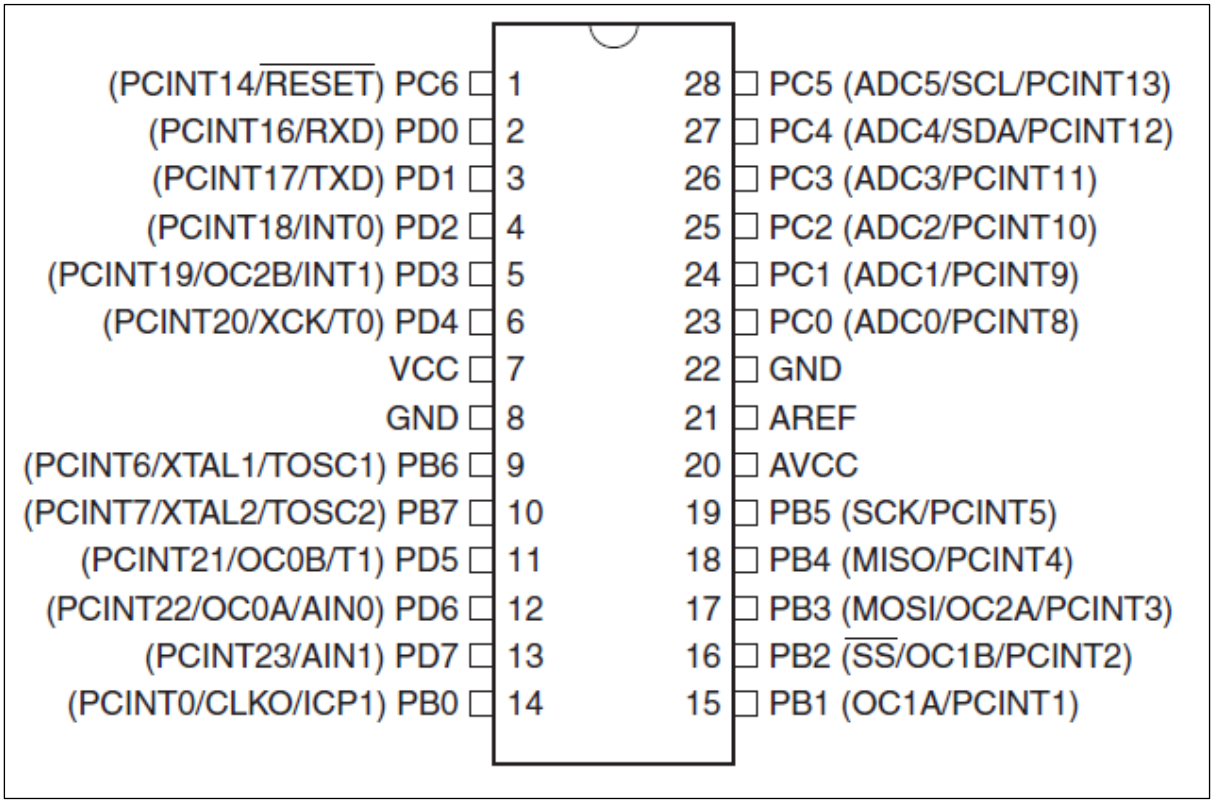


Figure 2: Pin diagram of ATmega328 MC

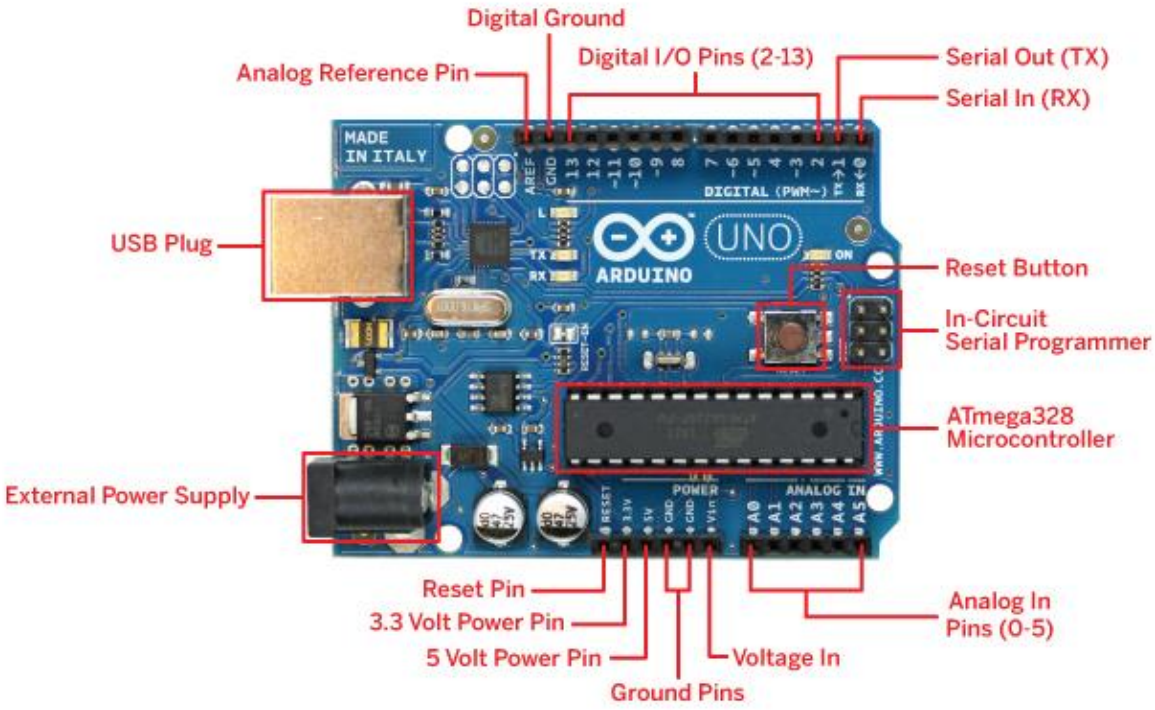
ARDUINO UNO BOARD

The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few Rupees and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Component Explanations:

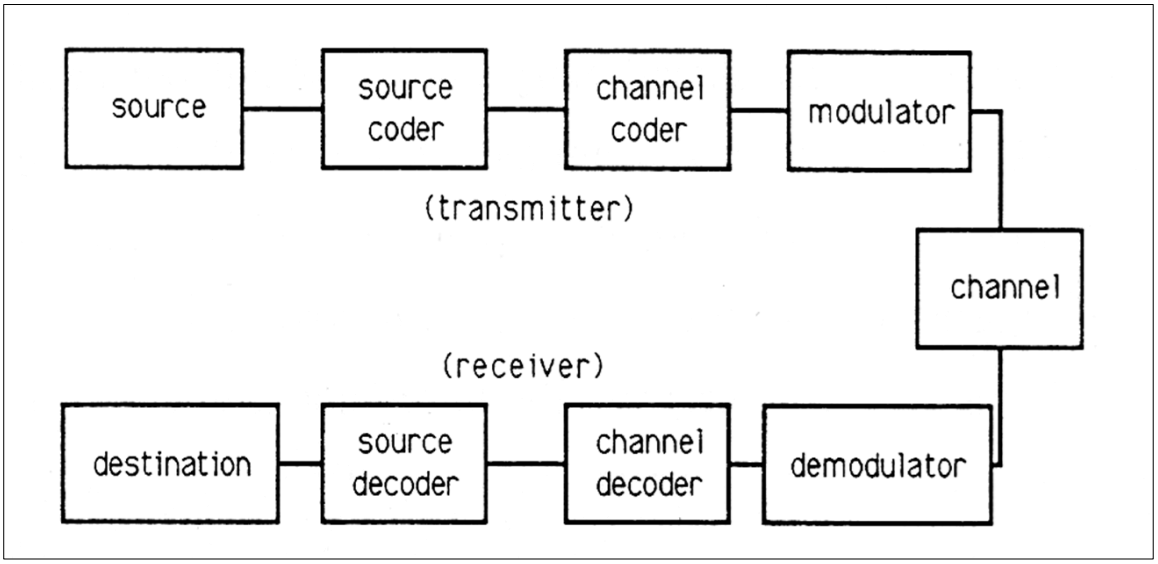
- ***Analog input Pins:*** Pins (A0-A5) that take-in analog values to be converted to be represented with a number range 0-1023 through an Analog to Digital Converter (ADC).
- ***ATmega328 chip:*** 8-bit microcontroller that processes the sketch you programmed.
- ***Built-in LED:*** In order to gain access or control of this pin, you have to change the configuration of pin 13 where it is connected to.
- ***Crystal Oscillator:*** clock that has a frequency of 16MHz
- ***DC Jack:***where the power source (AC-to-DC adapter or battery) should be connected. It is limited to input values between 6-20V but recommended to be around 7-12V.



COMMUNICATION

Communication is the activity of conveying information through the exchange of messages, or information. The system which is to displays the next station information. To establish the communication between the station and Train we using RF communication system.

5.1 Block diagram of Communication System



Transmitter
Transmitter is the transmitting part in this block diagram. Using this system we can generate the messages which are to be sent through this system.

Receiver
This is the Receiving part in block diagram of communication system. This can be said as the target to which the information needs to be delivered.

Encoder
Encoder is the second element in the communication system. It performs the encoding of the given data, which means that this system converts the messages in the form of symbols for transmission purpose. In this system, sequences of characters are created in a special format for an effective transmission. This encoding system is used for security purpose.
Decoder
Decoder is used to decode the encoded message and retrieve the actual message. Decoding must be done correctly. If this part is not performed well then the message which is received might not be correct.
This encoding and decoding will be very help full in military and mobile communications.

Channel
This is the main block in the block diagram of communication system. Noisy channel is nothing but the medium through which the message is transmitted. Messages are conveyed through this channel. Different channels have different strengths and weaknesses. Each channel has its own frequency and different applications have different operating frequencies.

Modulation and Demodulation
Modulation is a process, in which any one of the characteristics (Amplitude, Phase, and Frequency) of carrier wave is varied in accordance with the message signal.
Retrieving the original message signal from the Modulated signal is known as Demodulation.

4.1 BLUETOOTH COMMUNICATION (HC-05)

Bluetooth serial module is used for converting serial port to Bluetooth. These modules have two modes: master and slaver device. The device named after even number is defined to be master or slaver when out of factory and can't be changed to the other mode. But for the device named after odd number, users can set the work mode (master or slaver) of the device by AT commands.

HARDWARE IMPLIMANTATION

5.1 Regulated Power Supply Unit

Definition:

A power supply (sometimes known as a regulated power supply unit or RPSU) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

6.1.1 Block diagram

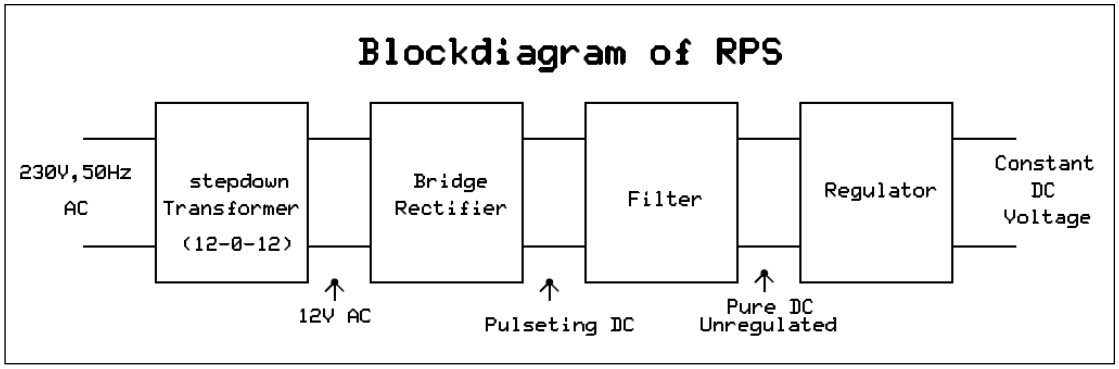
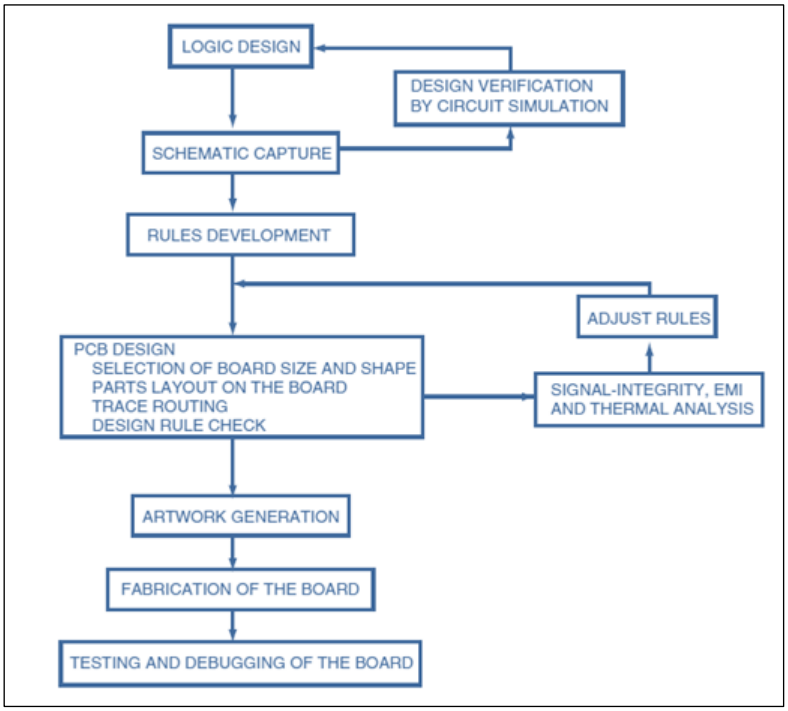


Figure 3: Block diagram of Regulated Power supply Unit

- The first section is the transformer. The transformer steps up or steps down the input line voltage and isolates the power supply from the power line.
- The rectifier section converts the alternating current input signal to a pulsating direct current. However, as you proceed in this chapter you will learn that pulsating dc is not desirable.
- For this reason a filter section is used to convert pulsating dc to a purer, more desirable form of dc voltage.
- 78xx chip family gives different output voltage as regulator. The last numbers in the chip code tells the output voltage.

Design flow



Throughout the manufacturing process of a PCB, visual and electrical inspection is carried out to locate any flaws that might have crept in due to process automation like ‘Tombstone effect’ when the solder is heated too quickly and one end of the component lifts up from the board failing to make contact, or excess flow of solder or bridging.

Even after the manufacturing process, the boards are tested for the output levels under varying conditions of environment, stress and strain.

Back in the olden days, when PCBs had just been introduced, military was the chief consumer. But as the technology progressed and as the need grew, more and more interest was diverted towards better PCBs and as of today, they serve as the base for a multitude of components, gadgets and devices ranging from ever innovating computers and cell phones to basic equipment's like television, radio and toys for children. Soon there are going to be more mobile phones than there are people in this world and the trend will continue to rise. This might be a convenience to the users, but isn't without hazards either, combating which offers great scope for people from diverse fields.

12. CONCLUSION

The Bluetooth-based fan speed control system is a smart, wireless, and scalable alternative to traditional fan regulators. It provides enhanced convenience through mobile-based operation and real-time display. This system is ideal for modern homes and offices where automation and user comfort are priorities. The successful integration of Bluetooth, Arduino, and motor control showcases the practicality and reliability of embedded systems in daily life.

13. REFERENCES

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