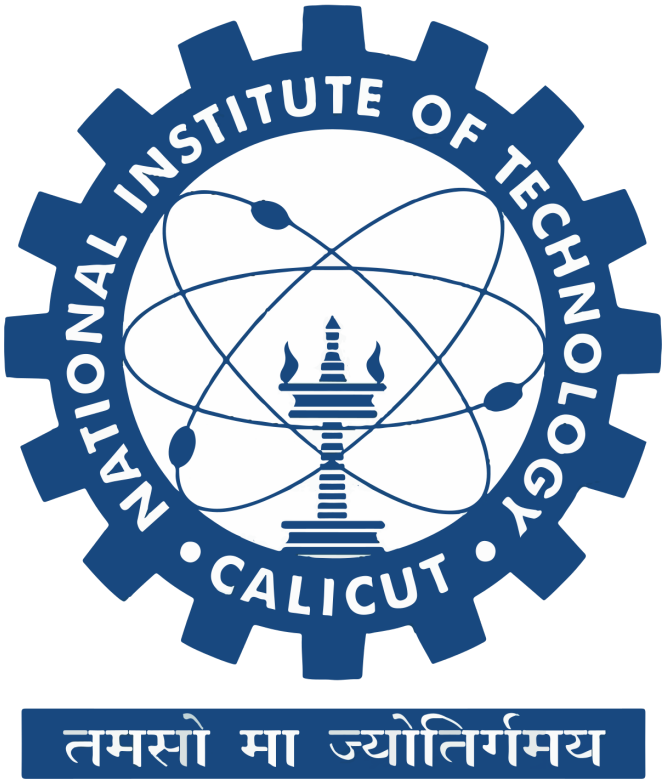
Automatic Hanger for Flats: A Space-Saving Solution



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Introduction

The challenge of limited living space in urban environments, particularly in high-rise apartment buildings, has prompted the need for innovative solutions that maximize the utilization of available space. People living in flats often face the dilemma of efficiently managing their living quarters, especially when it comes to everyday tasks such as drying and storing clothing.

This project introduces an inventive solution to address this challenge — an "Automatic Hanger" designed to significantly improve the functionality and convenience of managing clothing in space-constrained environments. The automatic hanger is particularly tailored to the needs of individuals and families residing in flats, where traditional clothes-drying methods may be impractical due to limited space or weather conditions.

The primary objective of this project is to present a prototype of the automatic hanger, showcasing its feasibility and practicality. By utilizing a stepper motor and an Arduino Uno microcontroller, this system offers an intelligent, space-saving, and user-friendly approach to clothes hanging and drying. It aims to simplify the everyday tasks of hanging, removing, and drying clothing while minimizing the footprint within a confined living space.

This report explores the project's development, including the system architecture, hardware components, software programming, mechanical design, and safety features. Additionally, it offers insights into the testing and calibration process, user interface considerations, and the creation of a user manual to guide users in the operation of the automatic hanger.

The "Automatic Hanger for Flats" not only addresses the spatial constraints faced by individuals living in flats but also emphasizes the significance of convenience, efficiency, and safety in daily living. As this project unfolds, it illustrates the potential for expanding and enhancing such innovative solutions for space optimization in contemporary urban living environments.

Motivation

The motivation behind the development of the "Automatic Hanger for Flats" project is rooted in the fundamental challenges encountered by individuals and families residing in urban flats and apartments. The project seeks to address and alleviate these challenges by introducing a practical and innovative solution for optimizing living spaces.

1. **Space Constraints in Flats:** Urbanization has led to the proliferation of high-rise apartment buildings, where living space is often at a premium. As a result, individuals and families face a perpetual challenge in finding efficient ways to utilize every square foot of their flats. Traditional clothes-drying methods, such as the use of standard clothing racks or outdoor clotheslines, are often impractical in these confined spaces.
2. **Environmental Considerations:** Weather conditions and outdoor air quality may further limit the options for drying clothes, making it essential to develop an indoor solution. Urban pollution, allergens, and varying weather patterns can hinder the effectiveness of outdoor drying, underscoring the need for an alternative approach.
3. **Convenience and Efficiency:** The project recognizes the importance of convenience and efficiency in daily living. Managing laundry and clothing is a routine task, and any innovation that simplifies this process can significantly enhance the quality of life for residents. The automatic hanger system aims to streamline these tasks, making the process as effortless as possible.
4. **Energy Efficiency and Sustainability:** The project aligns with the growing emphasis on energy efficiency and sustainability in modern living. By providing an indoor drying solution, it reduces the need for energy-intensive dryer machines and contributes to the reduction of electricity consumption, ultimately benefiting the environment.
5. **User-Centric Design:** This project is motivated by the desire to create a user-centric solution. By integrating user-friendly features, such as an intuitive interface and safety mechanisms, it seeks to enhance the overall user experience. The automatic hanger is designed with the user's comfort and convenience in mind.

6. **Innovation and Technology Integration:** The integration of a stepper motor and Arduino Uno reflects the project's commitment to leveraging technology for practical solutions. This innovative approach brings automation and intelligence to an everyday household task, aligning with the trend of smart and efficient living spaces.
7. **Potential for Broader Application:** While initially tailored for flat dwellers, the automatic hanger prototype showcases the potential for broader application. The concept of space optimization and user-focused design can be adapted and expanded to benefit a wider range of living environments.

In summary, the motivation behind the "Automatic Hanger for Flats" project is deeply rooted in the recognition of the challenges faced by individuals living in flats and the aspiration to provide a user-centric, efficient, and sustainable solution that addresses these challenges. The project's success not only contributes to improved daily living but also underscores the potential for innovative solutions in urban spaces.

Hardware Components

The **Arduino Uno** is an open-source microcontroller board based on the Microchip ATmega328P microcontroller (MCU) and developed by Arduino.cc and initially released in 2010. The microcontroller board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced with various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), and 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by a USB cable or a barrel connector that accepts voltages between 7 and 20 volts, such as a rectangular 9-volt battery. It has the same microcontroller as the Arduino Nano board, and the same headers as the Leonardo board. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

The word "uno" means "one" in Italian and was chosen to mark a major redesign of the Arduino hardware and software. The Uno board was the successor of the Duemilanove release and was the 9th version in a series of USB-based Arduino boards. Version 1.0 of the Arduino IDE for the Arduino Uno board has now evolved to newer releases. The ATmega328 on the board comes preprogrammed with a bootloader that allows uploading new code to it without the use of an external hardware programmer.

While the Uno communicates using the original STK500 protocol, it differs from all preceding boards in that it does not use an FTDI USB-to-UART serial chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Stepper Motor Description (Hardware Component)

One of the core hardware components used in the "Automatic Hanger for Flats" project is the stepper motor. A stepper motor is a type of electric motor that converts digital input pulses into precise mechanical motion. It plays a crucial role in automating the movement of the hanger system. Here's a detailed description of the stepper motor as a hardware component in your project:

1. Purpose and Function:

- **Automated Clothing Movement:** The stepper motor is employed to automate the process of raising and lowering the clothing hanger. It provides precise control over the positioning of the hanger, allowing for accurate and repeatable movements.

2. Type of Stepper Motor:

- **Bipolar Stepper Motor:** In this project, a bipolar stepper motor is used. Bipolar stepper motors have two coils, and their operation involves alternating the current direction through these coils to create steps. These motors provide accurate control over rotation.

3. Mechanical Specifications:

- **Size and Form Factor:** The stepper motor selected for the project is compact to fit within the system's design while offering sufficient torque for the task.
- **Shaft Diameter:** The motor's shaft diameter is compatible with the mechanical components of the hanger system, allowing for smooth rotation and coupling with the hanger assembly.

4. Electrical Specifications:

- **Voltage and Current Rating:** The motor's voltage and current ratings are compatible with the power supply and driver circuitry. This ensures that the motor operates within its specified parameters.
- **Step Angle:** The step angle, which is the angle through which the motor rotates for each step input, is an important specification. It determines the resolution and precision of the motor's movements. Common step angles include 1.8 degrees and 0.9 degrees.

5. Control and Driver Circuitry:

- **Microcontroller Interface:** The stepper motor is interfaced with an Arduino Uno microcontroller. The microcontroller generates the step pulses required to control the motor's movement.
- **Driver Circuit:** To provide the required current and voltage levels to the motor, a driver circuit is used. The driver interprets the digital signals from the microcontroller and controls the motor accordingly.

6. Mechanical Coupling:

- **Hanger Attachment:** The stepper motor is coupled to the hanger assembly through mechanical components such as gears, pulleys, or direct coupling. This ensures that the motor's rotation directly affects the movement of the hanger.

7. Advantages:

- **Precision:** Stepper motors are known for their precision and the ability to move in discrete steps, making them suitable for applications requiring accurate control.
- **Reliability:** Stepper motors are reliable and exhibit minimal wear and tear, providing a long service life.

8. Limitations:

- **Limited Speed:** Stepper motors may not be well-suited for high-speed applications compared to some other motor types.
- **Power Consumption:** The power consumption of stepper motors can be relatively high, especially when holding a fixed position.

The stepper motor, integrated with the Arduino Uno and appropriate driver circuitry, forms the heart of the automatic hanger system. It enables the controlled movement of the hanger, contributing to the efficiency and convenience of clothes hanging and drying within the constraints of a flat or similar living space.