Chapter One: Introduction

Introduction

The integration of computer systems in practical life has revolutionized many aspects of daily activities, from communication to transportation. One such application is the automation of parking systems, which addresses the growing need for efficient and user-friendly parking solutions in urban areas. The rotary parking system aims to optimize parking space usage, reduce the time and stress associated with finding parking, and minimize human errors in parking management.

Problem to be Solved

Limited parking spaces in urban areas.

Inefficient use of available parking spaces.

Time-consuming and stressful search for parking.

Human errors in parking management.

Project Goals

Provide a designated parking spot for each subscribing user to reserve a space in the garage.

Automate the parking process to reduce human intervention.

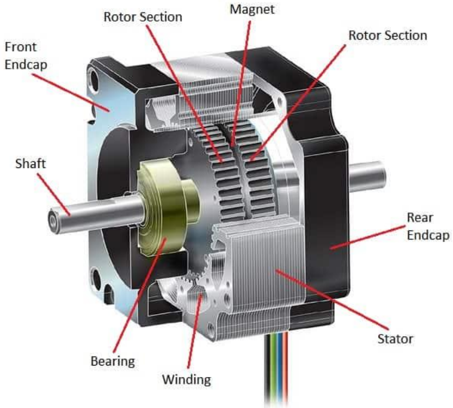
Optimize the use of vertical space in parking facilities.

Enhance user convenience and experience.

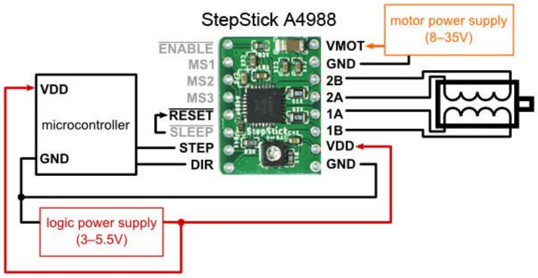
Tools Used in the Project

Arduino Mega

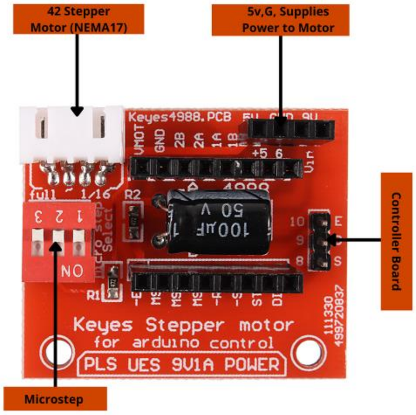
Stepper Motor



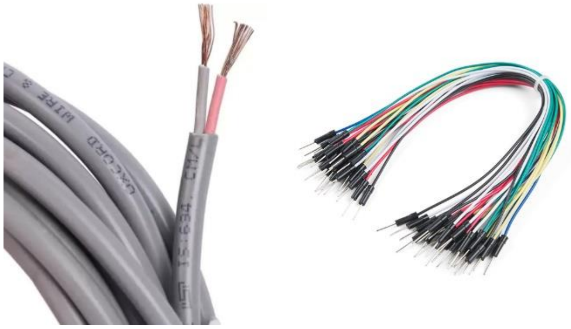
A4988 Stepper Motor Driver



Expansion Board for A4988


42 Stepper Motor (NEMA17)
5v,G, Supplies Power to Motor
Controller Board
Microstep
Keyes4988.PCB
Keyes Stepper motor for arduino control
PLS UES 9V1A POWER

Wire and Jumper Wires

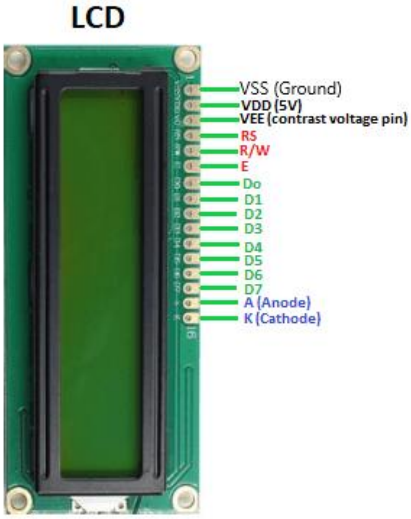


Power Supply (12V 10A)

Gear

GT2 6mm Open Timing Belt

LCD



Numpad

Chapter Two: Introductory and Detailed Studies

Theoretical Background

Existing parking systems range from simple manually operated lots to complex automated systems. Traditional parking lots often suffer from inefficient space utilization and high operational costs. Automated parking systems, while more efficient, can still have limitations such as high setup costs and reliance on manual intervention for certain tasks.

Existing System Problems

Inefficient space utilization.

High operational costs.

Limited automation and reliance on manual operations.

High likelihood of human error.

Objectives of the New System

Full automation of the parking process.

Efficient use of vertical space.

Reduction of human error.

Enhanced user convenience.

Feasibility Study

The feasibility study includes a cost-benefit analysis, considering the initial setup costs against the long-term benefits of automated parking. The study also outlines the construction plan, detailing the steps required for system implementation, from hardware setup to software integration.

Chapter Three: Designing the System or Application

System Architecture

The rotary parking system is designed as a vertical tower with multiple parking spaces. Each space is controlled by a stepper motor, which moves the platform to the desired position. The Arduino Mega serves as the central controller, interfacing with the stepper motors, LCD, and numpad.

Designing Tables

The system utilizes several tables to manage data:

User Table: Stores user information, including membership status and assigned parking space.

Parking Space Table: Tracks the status of each parking space (occupied, reserved, available).

Transaction Table: Logs parking and retrieval activities.

Design Procedures, Algorithms, and Schemes

The system design involves several key algorithms:

Parking Space Allocation Algorithm: Each subscribing user has a designated parking spot for them in the garage.

Stepper Motor Control Algorithm: Calculates the steps required to move the platform to the desired position.

User Authentication Algorithm: Verifies user credentials and retrieves their assigned parking space.

Data Dictionary

Arduino Mega: A microcontroller board used for controlling the system.

Stepper Motor: A type of motor that moves in discrete steps, providing precise control.

A4988 Stepper Motor Driver: A driver that controls the stepper motor.

Expansion Board: A board that facilitates easy connection of multiple stepper motor drivers.

LCD: A display screen used for user interface.

Numpad: A keypad used for user input.

Chapter Four: Implementing the System or Application

Project Idea

The project revolves around creating an automated rotary parking system where each user has a reserved parking space. The system aims to automate the parking process, ensuring each member has a dedicated space, which is managed through an automated system driven by stepper motors controlled by an Arduino Mega. When a user drives into the parking area, the system checks if the user has a reserved spot and guides them accordingly.

System Shape and Functionality

The system is structured as a vertical tower containing multiple parking spaces arranged in a rotary manner. Each parking space can move vertically using stepper motors, allowing cars to be parked and retrieved without manual intervention. The base level is always empty to facilitate the rotation of parking spaces. Non-subscribed users cannot park in the tower, ensuring that only registered members use the designated spaces.

How the System Works

User Detection and Verification: Upon arrival, a camera detects the car's license plate and checks the database to verify if the user has a reserved parking spot.

Parking Space Assignment: If a reserved spot is available, the system sends the parking space number to the Arduino Mega, which controls the stepper motor to move the designated parking platform to the ground level.

Parking Process: The user drives the car onto the platform and exits the vehicle. The LCD displays a message: “If you want the car to park, press #.” When the user presses # on the numpad, the stepper motor moves the platform back to its designated vertical position.

Retrieval Process: When the user returns, they press * on the numpad, and the system prompts them to enter their parking space number. The platform then moves to the ground level, allowing the user to retrieve their car.

Project Explanation

The system's core functionality relies on precise control of the stepper motors, which operate in steps (200 steps per revolution). Each parking space corresponds to a specific number of steps. For instance, if a parking space requires 40 steps to descend, it will need -

40 steps to return to its original position. This precise movement ensures that each parking and retrieval operation is smooth and accurate.

System Components and Setup

A4988 Stepper Motor Driver and Expansion Board: Connect the A4988 drivers to the expansion board and then to the stepper motors using jumper wires. The expansion board is then connected to the Arduino Mega.

Power Supply (12V 10A): Connect the power supply to the system using appropriate wiring to ensure sufficient power for the stepper motors and other components.

Mechanical Setup: Connect the stepper motors to the gears and the GT2 6mm Open Timing Belt, enabling the vertical movement of parking platforms.

User Interface: Connect the LCD and numpad to the Arduino Mega using jumper wires. The LCD displays messages and prompts for the user, while the numpad allows user input.

The system ensures a seamless parking experience by automating the entire process, reducing the need for manual intervention, and maximizing the use of vertical space.

System Configuration Settings

Initial configuration involves setting up the Arduino Mega, connecting the stepper motors and drivers, and configuring the LCD and numpad. The power supply is connected to provide the necessary voltage and current for the system.

System Screens

Home Screen: Displays a welcome message and prompts the user to press a key.

Parking Screen: Displays "Press # to park your car."

Retrieval Screen: Displays "Press * to retrieve your car."

Input Screen: Prompts the user to enter their parking space number.

Error Messages

"Invalid Input": Displayed when the user enters an incorrect parking space number.

System Reports

Usage Report: Summarizes the number of parking and retrieval operations performed.

Inquiries

Parking Availability Inquiry: Allows users to check the availability of parking spaces.

User Status Inquiry: Provides information on user membership status and assigned parking space.

Chapter Five: Conclusions and Future Work

Conclusions

The rotary parking system successfully addresses the issues of inefficient space utilization and manual intervention in traditional parking systems. By automating the parking process, the system enhances user convenience and optimizes the use of vertical space.

Pros and Cons of the System

Pros:

- Full automation reduces the need for manual intervention.
- Efficient use of vertical space maximizes parking capacity.
- Enhanced user experience with easy-to-use interface.

Cons:

- High initial setup cost.
- Requires regular maintenance to ensure reliable operation.

Future Works

Enhancements: Integrate advanced sensors for improved vehicle detection and positioning.

Expansion: Develop a mobile application for remote parking space reservation and monitoring.

Optimization: Implement machine learning algorithms to optimize parking space allocation and reduce waiting times.