Chapter One: Introduction

Introduction:

In today's fast-paced urban environments, efficient utilization of space and resources is paramount. Parking management systems play a crucial role in addressing the challenges associated with limited parking spaces and growing vehicular traffic. This report focuses on the implementation of smart streetlights within a smart parking system to enhance user experience and optimize energy consumption.

Problem to be solved:

Traditional parking systems often suffer from inefficiencies such as inadequate guidance for drivers, resulting in time wastage and increased frustration. Additionally, conventional street lighting solutions lack adaptability, leading to unnecessary energy consumption and environmental impact.

Project goals:

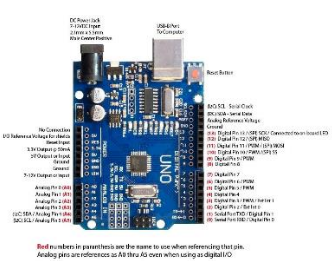
Provide real-time guidance to drivers for efficient parking.

Optimize energy usage through adaptive street lighting.

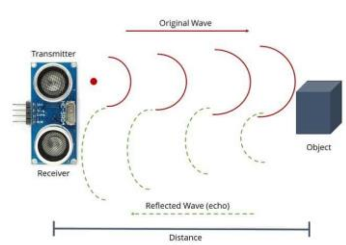
Enhance overall user experience and convenience in parking facilities.

Tools used in the project:

Arduino Uno Board



Ultrasonic Sensor HCSR04



Test Board Mini

White LEDs and Resistors

Jumper Wires

Chapter Two: Introductory and Detailed Studies

Theoretical background about the existing system or application:

Traditional parking systems rely on static signage and limited space utilization strategies, leading to inefficiencies in parking management.

Problems with the existing system or application:

Lack of real-time guidance for drivers, resulting in congestion and frustration.

Inefficient energy usage in conventional street lighting solutions.

Objectives of the new system or application:

Provide real-time guidance to drivers for efficient parking.

Optimize energy consumption through adaptive street lighting.

Feasibility study, system construction plan or proposed application:

The proposed system aims to address the shortcomings of traditional parking management by integrating smart streetlights with advanced sensor technologies.

Chapter Three: Designing the System or Application

System architecture or proposed application:

The smart parking system consists of interconnected components including ultrasonic sensors, Arduino boards, and white LEDs. Data from sensors inform the behavior of streetlights to guide drivers effectively.

Designing tables (project files):

Tables detailing sensor data, LED control logic, and system configurations facilitate efficient system management and maintenance.

Design procedures, algorithms, and schemes:

Algorithms are developed to control the behavior of streetlights based on real-time sensor inputs, optimizing lighting intensity based on parking space occupancy.

Sensor Buffer and Error Mitigation

To address the issue of sensor error, a concept known as the **sensor buffer** is implemented. This buffer consists of the distances that are intentionally left behind during measurements. The purpose of the sensor buffer is to account for and mitigate inaccuracies that may arise from sensor readings, thereby enhancing the reliability and precision of the collected data.

By incorporating a sensor buffer, the system can effectively reduce the impact of potential errors, ensuring more accurate and consistent performance in various applications.

Data dictionary:

A comprehensive data dictionary is provided in the appendix, detailing terms and variables used within the system for clarity and reference.

Chapter Four: Implementing the system or application.

System or application configuration settings:

Upon entering the gate, the system initiates by activating LED1 to indicate the gate's opening. Subsequently, the behavior of the LED lights is governed by the distance measured by ultrasonic sensors.

System behavior based on ultrasonic sensor readings:

- Distance between car and ultrasonic sensor 1:
  - 31 to 29 cm: Only LED2 lights up.
  - 29.5 to 21 cm: LED2 and LED3 illuminate.
  - 21.5 to 20 cm: Only LED3 lights up.
  - 20.5 to 12 cm: LED3 and LED4 illuminate.
  - 12.5 to 7 cm: Only LED4 lights up.
  - Below 7.5 cm: LED4, LED5 and LED6 lights up, indicating the need to maneuver around the tower.
- After maneuvering around the tower, when the distance between the car and ultrasonic sensor 2 is:
  - Below 4 cm: LED5 and LED6 illuminate.
  - 7 to 4.5 cm: LED6 and LED7 illuminate.
  - 13 to 7.5 cm: Only LED7 illuminates.
  - 15 to 13.5 cm: LED7 and LED8 illuminate.
  - 18 to 15.5 cm: Only LED8 illuminates.
  - 23 to 18.5 cm: LED8 and LED9 illuminate.

In all other cases, all LEDs remain off to indicate no specific instruction or action required.

By configuring the system according to these settings, efficient guidance for drivers is ensured, optimizing the parking process, and enhancing user experience.

System or application screens:

User interfaces allow for monitoring and control of the smart parking system, providing real-time feedback on parking space availability and lighting status.

System or application reports:

Generated reports include parking occupancy statistics, energy consumption data, and system performance metrics to aid in system optimization and decision-making.

Inquiries:

User queries such as checking parking availability and accessing historical data are supported within the system for enhanced user experience.

Chapter Five: Conclusions and Future Work

Conclusions:

The implementation of smart streetlights within the smart parking system has demonstrated significant improvements in parking efficiency and energy savings. By providing real-time guidance to drivers and optimizing street lighting based on parking occupancy, the system enhances user experience while reducing environmental impact.

Pros and cons of the system or application:

Positives:

- Improved parking efficiency and user experience.
- Optimized energy consumption through adaptive lighting.

Cons:

- Initial setup and implementation costs.
- Dependency on sensor accuracy and reliability.

Future works:

- Integration with mobile applications for seamless user interaction.
- Exploration of renewable energy sources for powering smart streetlights.
- Implementation of advanced analytics for predictive parking management.
- Placing solar cells, relying on the sun’s energy during the day, storing it and using it at night.