Automated Car Parking System Using BeagleBone Black

Real-time Parking Management and Automation

PRESENTED BY:

GROUP 5:

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Project Objective

To develop a fully automated parking management system leveraging BeagleBone Black, IR sensors, and servo motors for efficient car detection, gate control, and real-time parking availability display.

System Capabilities:

- **Car Detection:** Real-time identification for parked vehicles using IR sensors.
- **Automated Gate Operations:** Servo motor will be manage the entry and exit gates based on parking space availability in the lot.
- **User Interface:** The user interface features intuitive red and green LED indicators for clear, immediate visibility of parking spot availability.
- **Scalability:** The system design allows for easy expansion to larger parking facilities.

Hardware Overview

- **BeagleBone Black:** This serves as the central processing unit for our project.
- **IR Sensors:** These are used for detecting the vehicle presence at every parking space.
- **Servo Motor-SG90:** This controls gate movements based on IR sensor data.
- **Additional Components:** Breadboard and jumper wires for circuit connections.

Challenges Faced

- **LCD Display Limitations:** Initial design included an LCD which was later removed due to space and visibility issues.
- **Motor Configuration:** Restriction to a single motor required innovative control techniques.

Solutions Implemented

- **LED Indicators:** Switched to intuitive LED signals for spot availability, enhancing user experience from a distance.
- **Bidirectional Gate Control:** Developed a control scheme for one motor to handle both entry and exit, simplifying the hardware setup.

Software Framework:

- **Development Language:** C++ to ensure low-level control and efficient execution.
- **Libraries:** We are going to use GPIO library called WiringBone for hardware interface management.

Planned vs. Actual Accomplishments

- **LCD Display vs. LED Indicators:**
  - **Planned:** Utilize an LCD display to show the number of available parking slots.
  - **Actual:** Replaced the LCD display with red and green LEDs to indicate parking spot availability, enhancing visibility and simplifying the design.
- **Gate Motors Configuration:**
  - **Planned:** Use two separate motors with unilateral rotation for each the entry and exit gates.
  - **Actual:** Implemented a single motor with bidirectional functionality, efficiently controlling both entry and exit gates, reducing complexity and hardware requirements.

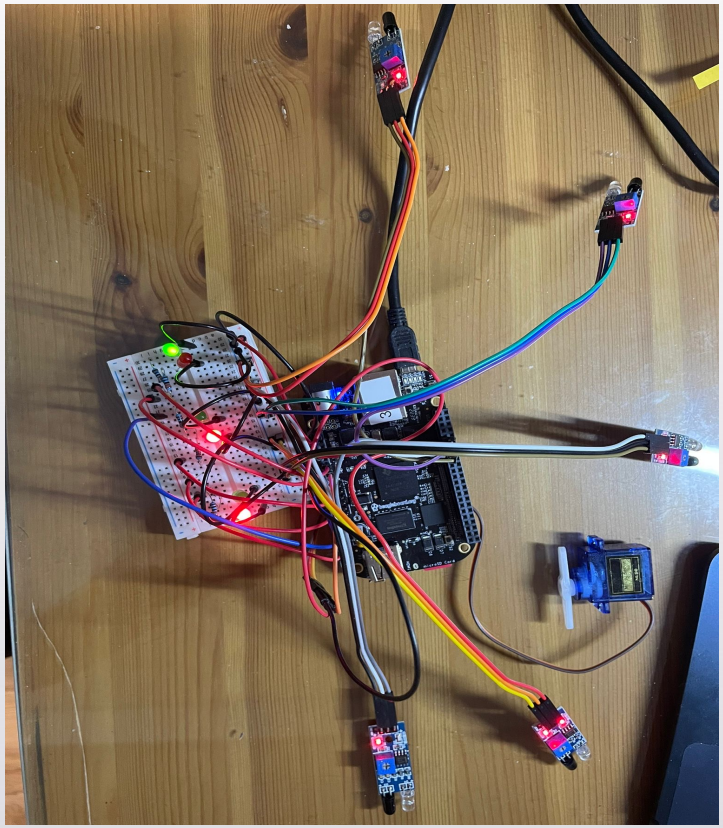
System Operation Workflow

1. **Vehicle Detection:** IR sensors detect the presence of vehicles at entry and exit points.
2. **LED Updates:** Green LEDs indicate available spots; red LEDs show occupied spots.
3. **Gate Control:** A bidirectional servo motor operates the gates for both entry and exit.
4. **Central Management:** BeagleBone Black coordinates all activities, ensuring efficient workflow.

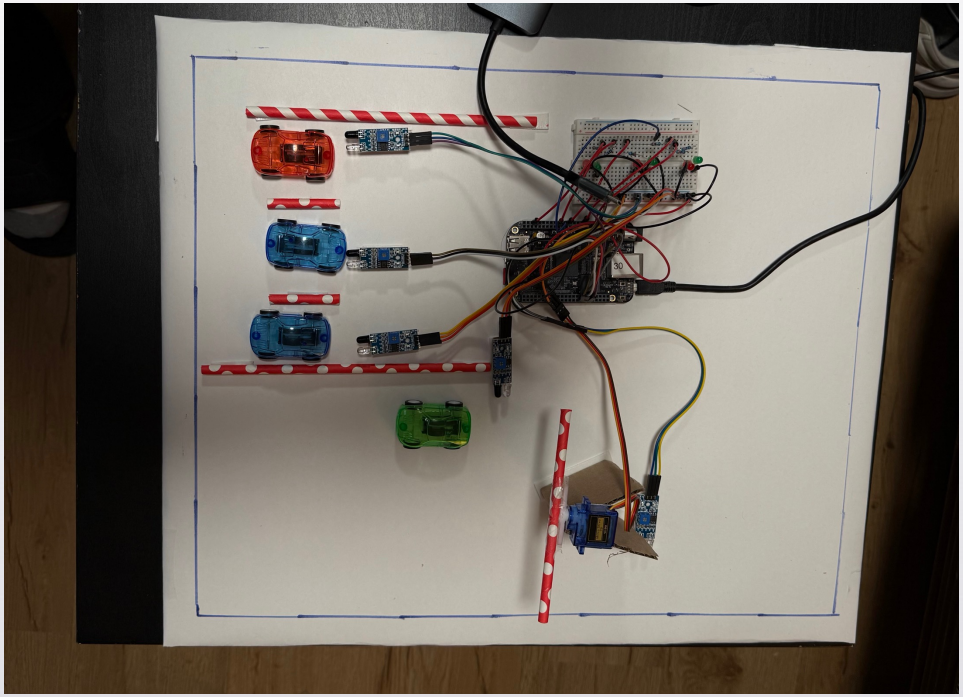
Project Highlights

- **Efficient Management:** Automated detection and gate control reduce the need for manual intervention.
- **Testing Analysis:** Using GCOV we attained about 75% test coverage in functions, we would've take it to 100% but due to time constraints and hardware restrictions.
- **Visual Communication:** Clear LED indicators provide instant parking status to drivers.
- **Simplified Hardware:** A single bidirectional motor for gate operations enhances system reliability.
- **Scalable Design:** Modular architecture allows for easy expansion and integration of additional features.

Initial Setup



Final setup



Thank you