



# Smart Technologies for Efficient Crowd Control and Real-time Monitoring in Public Transist System

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**Abstract:** Efficient crowd management in public transportation enhances passenger comfort, safety and operational efficiency. This project introduces a smart allotment system for managing crowds in public transport, focusing on real-time monitoring of bus capacity and bus stop crowd density. The system comprises two modules: the bus module and the bus stop module. The bus module uses an ESP32 microcontroller, IR sensors for passenger counting, and a DC motor for automated door control. Real-time seat availability is displayed on an LCD within the bus and shared with the bus depot via Zigbee communication.

**Keywords:** ESP32, Microcontroller, IR Sensors, DC Motor, Zigbee module, LCD Display.

## I. INTRODUCTION

Efficient crowd management in public transport is crucial for reducing passenger waiting times and ensuring a seamless, comfortable travel experience. The increasing urban population has led to overcrowded bus stops and unpredictable seat availability, resulting in delays and passenger frustration. To address these issues, this project proposes a “Smart Allotment System for Public Buses,” integrating advanced technologies to monitor seat occupancy and crowd density at bus stops in real-time.

The system consists of two main components: a seat availability tracking module within the bus and a crowd detection system at bus stops. The seat availability module uses an Arduino Uno with IR sensors to track passengers boarding and exiting the bus, updating real-time seat availability on an LCD display. This feature allows passengers to easily check the number of available seats, helping reduce confusion and improve boarding efficiency.

## II. LITERATURE SURVEY

[1] The 89v51 microcontroller and embedded systems, from this book we studied the instruction set of C language 89v51. We studied information and programming of interfacing of LCD.

[2] www.PHILLIPS.com from this web site we studied about the microcontroller P89V51 and its pin description and pin configuration.

[3] LCD Tutorial for interfacing with microcontroller 8051 we studied and collected the information about interfacing tutorials, LCD tutorial, 8051 assembly language programming.

[4] <http://www.NSK Electronics.com>, from this we got data sheet of microcontroller (Phillips) module.

[5] www.smallslate.com from this web site we downloaded information regarding the MAX232 and its working.

[6] www.philips.com: From this website we studied about the microcontroller P89V51 and its pin description and pin configuration. The P89V51 low power and a high performance volatile 8 bit microcomputer with 64K bytes of flash and 1024 bytes of data RAM. This is manufactured using Philips Corporation volatile Memory technology and is compatible with both TTL and CMOS logic. It has 40DIP.



[7] LCD interfacing with microcontroller: We studied how the LCD is interfacing with the microcontroller. LCD's combine the properties of both liquids and crystals. LCD consist of two glass panels, with the Liquid Crystal material sandwiched in between them. The inner surfaces of the glass plates are coated with transparent electrodes, which define the character, symbols or patterns to be displayed.

### III. METHODOLOGY

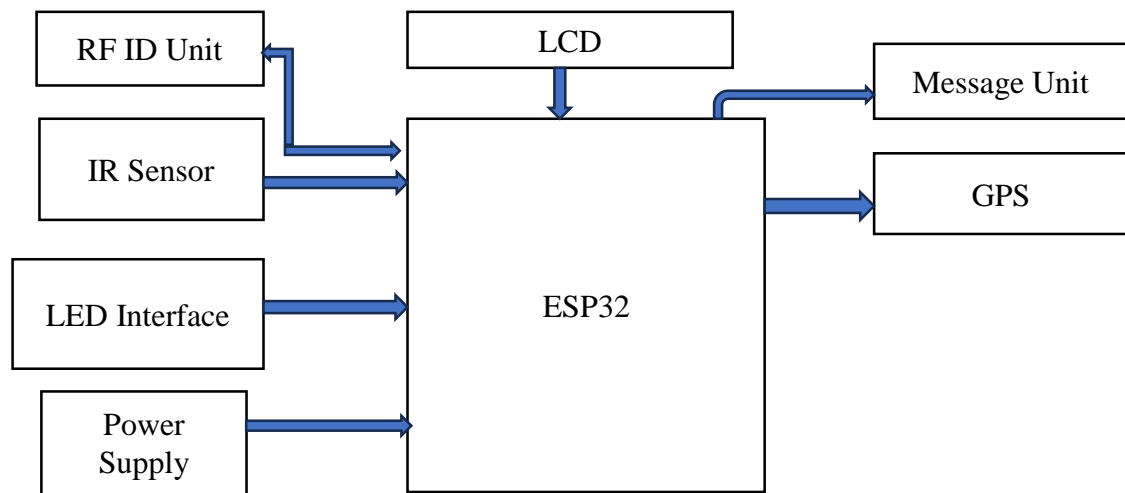


Fig.1. Block Diagram

The methodology for implementing smart technologies for efficient crowd control and real-time monitoring in public transit systems involves a structured approach combining technological solutions, data analytics, and operational strategies.

### IV. HARDWARE AND SOFTWARE DESCRIPTION

#### Hardware Requirements

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty.

Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit. ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems

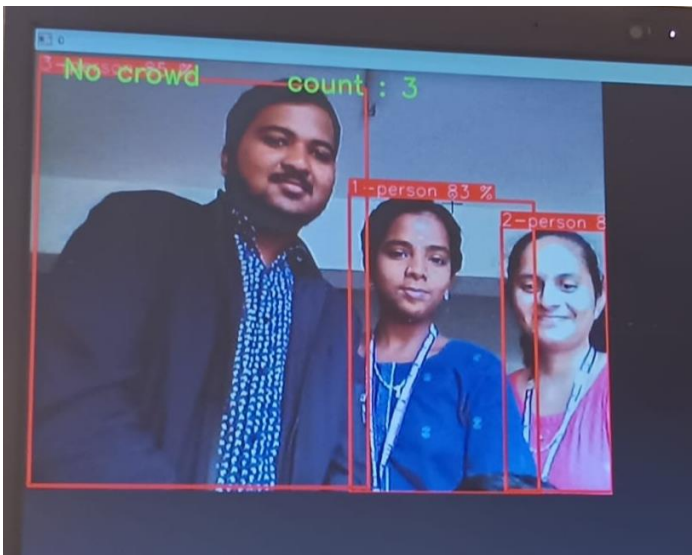
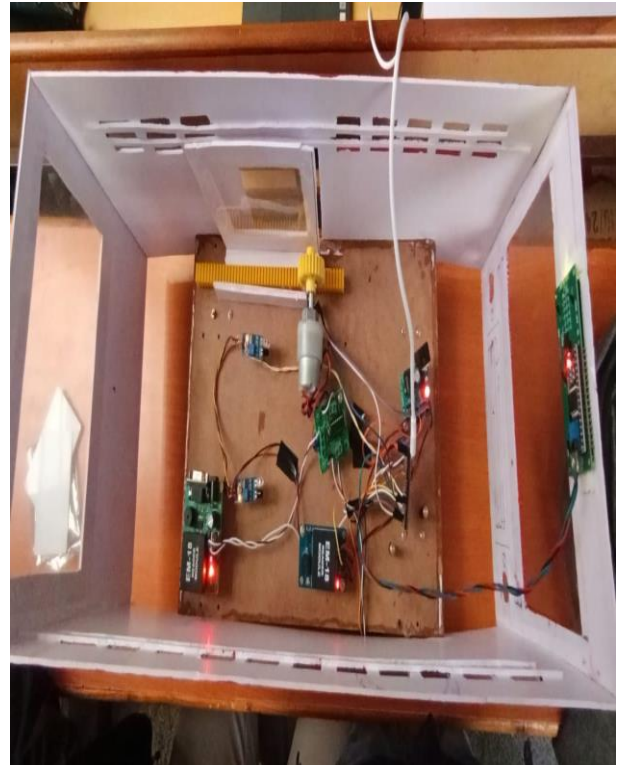
#### Software Requirements

Keil development tools provide a comprehensive solution for 8051 microcontroller software development, catering to both professionals and beginners. The CA51 Compiler Kit supports all 8051 derivatives from manufacturers like Atmel, Intel, Philips, and Texas Instruments. Key features include support for nine basic data types, 32-bit IEEE floating-point, flexible memory allocation (bit, data, data, etc.), and interrupt functions written in C. It also supports dual data pointers, bit-addressable data objects, and the RTX51 real-time operating system. Debugging is enhanced with complete symbol and type information. The development process involves selecting the target chip from the device database, configuring tool settings, creating source files in C or assembly, building the application, correcting errors, and testing on target hardware. The A51 assembler translates assembly language into executable machine code, supporting the entire 8051 instruction set. Its macro features save development time by reusing common code sequences.



V. RESULTS

smart crowd management system for public transportation using RFID and IoT. It replaces traditional paper tickets with RFID-based e-tickets linked to a centralized database. Passengers use rechargeable RFID cards for automated fare deduction, with journey details sent via SMS. GPS integration ensures precise tracking, while Wi-Fi facilitates data transmission. The system addresses issues like overcrowding, ticket fraud, and hygiene concerns, especially during pandemics. It promotes eco-friendliness by reducing paper waste and enhances passenger security by maintaining detailed records. Additional features include real-time seat tracking and notifications for parents of schoolchildren, modernizing and streamlining public transport operations.



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