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Normal and Emergency Modes Using Group Elevator Scheduling With Advance Information

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ABSTRACT*:* Scheduling a group of elevators in a building has long been recognized as an important issue to improve transportation efficiency, since elevator service ranks second after heating, ventilation and air conditioning as the main complaints of building tenants. The problem, however, is difficult because of complicated elevator dynamics, uncertain traffic in various patterns, and the combinatorial nature of discrete optimization. With the advent of technologies, one important trend is to use advance information collected from devices such as destination entry, radio frequency identification and sensor networks to reduce uncertainties and improve efficiency. This paper implements the optimized scheduling of a group of elevators with destination entry and future traffic information for normal operations and coordinated emergency evacuation. To overcome the difficulties caused by traffic uncertainties, one important trend is introduced to explore advance information. Most of conventional elevators have simple up and down buttons for hall calls, and destinations are not known until passengers placed car calls from inside an elevator. This system has keypads to enter passenger destination floors, and destinations are known in advance. The operation of the elevators will vary for different modes like normal and emergency modes. In the normal mode the lift in the nearest floor will move to the destination. The floors are identified through IR sensing. In the emergency situation where smoke is sensed in any of the floors all the lifts will move to that particular floor. Movement of the lift in this mode will be faster compared to the normal mode. Time based Scheduling with Genetic algorithm and Nested partitions are used for the scheduling of the group of elevators.

KEYWORDS : Elevator Scheduling, Discrete Optimization, DC motor Driving Circuits, IR Sensors, LCD Display, VLSI Peripheral Bus**.**

1. INTRODUCTION

Group elevator scheduling is important to transportation efficiency for mid-rise and high-rise buildings, and how to improve the service quality of elevators has received considerable attention. In conventional elevator systems, only up and down buttons are available for hall calls, and passengers cannot specify their destinations until they enter the elevators. The systems need to make decisions in the presence of uncertainties on passenger arrival times and destinations. Such decisions are sometimes unsatisfactory. For instance, passengers often have a long wait for the next elevator because they missed an elevator that left a few seconds previously; passengers often have to wait for the door to close even if no one is going to board. The reason why these two phenomena arise is that due to lack of traffic information, the elevator systems have to rely on door dwell time, the minimum time interval to keep the door open, to decide when to close the door.

To cope with traffic uncertainties, advanced technologies have been introduced to collect and predict traffic information. In a Destination Entry system, passengers can enter their destinations through keyboards before they get into the cars. For these systems, passenger arrival times, origins, and destinations are known before the systems make decisions.

The latest advancements in sensor technology and information technology further open up the possibility to

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collect future traffic information within a certain time window. Beyond such information, statistical data and/or statistical forecasts have been exploited to create virtual future passenger traffic. More information enables the development of elevator systems with better performance.

Nevertheless, traditional elevator scheduling methods do not have mechanisms to utilize advance information collected, and it remains an open and challenging issue to develop new ones which can effectively utilize such information. This problem is difficult because of various traffic patterns, complicated car dynamics, and combinatorial explosion of the search space. Advance information has been modeled by assuming that traffic information (i.e., passenger arrival times, their origins and destinations) within a look-ahead time window is fully available. Then the waiting time and the door dwell time is considerably reduced as the controller has information in advance. The elevator system is also provided with options for emergency evacuation in case of fire alarm or any other emergency situations where the elevator cars move with an increased speed than the normal. Thus the group elevator system is enhanced for better performances[2].

II. LITERATURE REVIEW

2.1 Existing System

Most of conventional elevators have simple up and down buttons for “hall calls,” and destinations are not known until passengers placed “car calls” from inside an elevator. It takes more time for the passengers to move to the destination as the requested lift might be in top floor and other lift may be in the near by floors[1].

2.1.1 Drawbacks in Existing System

1. More Power Consumption.
2. Increase Traffic.
3. Take more Traveling Time.
4. More waiting time.

2.2 Related Literature Views

Before going to implement any design it is worth taking a look at what is available in the literature regarding Group elevator scheduling. A substantial amount of research work has been put into developing efficient system of group elevator control. This section presents some of the design reported in these journals and their features. David L. Pepyne and Christos G. Cassandras has worked on Optimal dispatching control for elevator system.

Zavarin Gagov, Young Cheol Cho, Wook Hyun Kwon has worked on the concept for the derivation of velocity profiles for elevator systems.

2.3 Proposed System

The system has keypads to enter passenger destination floors, and destinations are known in advance. Beyond such keypads, future passenger arrival and destination information might be collected from entrance systems[3][4]. The speed of the elevator cars increase in emergency mode comparatively than normal mode. Emergency mode is given higher priority helping emergency evacuation

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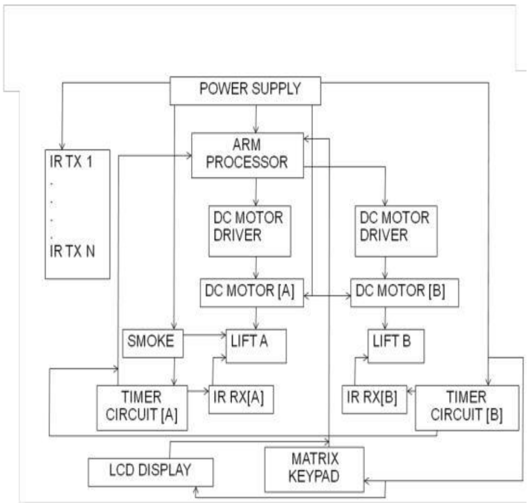
2.3.1 Block Diagram



2.3.2 Block Explanation

Block Comprises of Two Elevators with processor, DC motors, Driver Circuit, IR Sensors, Smoke Sensors, LCD Display, Timer and Matrix Keypad. Input is given through keypad and LCD is to display the floors. IR Transmitters are placed in the floors and IR receivers in the Lift. In the normal mode when input is received from the user the Processor will process based on timer scheduling and move to nearest lift to the destination. In the emergency mode when smoke is sensed in any of the floors at a time all the lifts will be moved to the particular destination with the increased speed than normal mode. The lift is operated using DC motor driven by the DC Motor Driving Circuit[5].

III. HARDWARE SPECIFICATIONS

3.1 ARM

ARM means advanced RISC machine. Compared to pic microcontroller ARM has a wide range of application. Speed of this controller is also very high compared to all others. It has an inbuilt memory for the program as well as data. The general description of the ARM based controller used here is given below.

3.1.1 Architectural Overview

The LPC2141/2/4/6/8 consists of an ARM7TDMI-S CPU with emulation support, the ARM7 Local Bus for interface to on-chip memory controllers, the AMBA Advanced High-performance Bus (AHB) for interface to the interrupt controller, and the VLSI Peripheral Bus (VPB, a compatible superset of ARM's AMBA Advanced Peripheral Bus) for connection to on-chip peripheral functions. The LPC2141/24/6/8 configures the ARM7TDMI-S processor in little-endian byte order.. Each AHB peripheral is allocated a 16 kB address space within the AHB address space. LPC2141/2/4/6/8 peripheral functions (other than the interrupt controller) are connected to the VPB bus. The AHB to VPB bridge interfaces the VPB bus to the AHB bus. VPB peripherals are also allocated a 2 megabyte range of addresses, beginning at the 3.5 gigabyte address point. Each VPB peripheral is allocated a 16 kB address space within the VPB address space[6]-[8].

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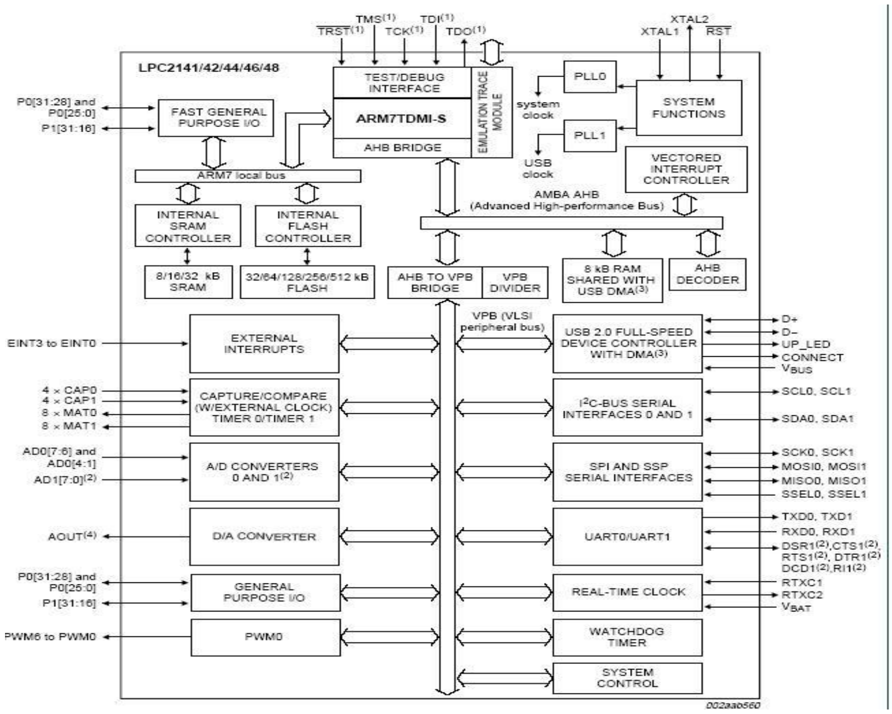
3.1Block diagram



3.1 Block diagram of the controller
3.2

3.2 DC Motor

A DC motor is an electric motor that runs n direct current(DC) electricity. The DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary permanent magnets, and rotating electrical magnets. It works on the principle of Lorentz force, which states that any current carrying conductor placed within an external magnetic field experiences a torque or force known as Lorentz force[9][10].

3.2.1 Motor Driver Circuit (DRIVER-L293D):

The L293D is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors.

3.2.2 Features

1. 600mA. Output current capability per channel.
2. 1.2A peak output current (non repetitive) per channel.
3. Enable facility.
4. Over temperature protection.
5. Logical “0” input voltage up to 1.5V (High noise immunity).
6. Internal clamps diodes.
7. **L293D is two channels DC motor driver which can handle 2 motors at the same time.**

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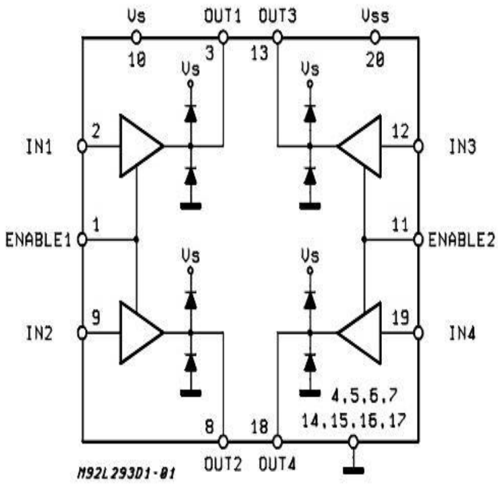
3.2 Block Diagram



3.3 Block diagram of L293D

3.3 LM393 Voltage Comparator

LM393 consist of two independent voltage comparators, designed specifically to operate from a single power supply over a wide voltage range. It is a Low Power Low Offset Voltage Dual Comparator[11].

3.3.1 Advantages

1. High precision comparators
2. Reduced VOS drift over temperature
3. Eliminates need for dual supplies
4. Allows sensing near ground
5. Compatible with all forms of logic
6. Power drain suitable for battery operation

3.4 IR Sensor

Infrared(IR) light is electromagnetic addition with a wavelength between 0.7 and 300micrometres. IR wavelengths are longer than that of visible light. Here the Infra red sensor is used for the elevator car to halt at each floor.

3.5 Gas Sensor

The gas sensor is used to sense the smoke and thus act as an alarm system which helps in the emergency evacuation.

3.6 MAX 232

The MAX232 is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals.

3.7 Keypad

The Keypad is 4*5 Matrix Type. This is used as the destination entry system.

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IV. FORMULATION AND METHODOLOGY

4.1 Problem Formulation

The future traffic information is modeled by using a look-ahead time window where traffic information within the window is assumed available, and ignored otherwise. The passengers are sorted in the ascending order of their arrival times. Then a two-level integer programming formulation is established with the high-level passenger-to-car assignment and the low-level passenger-to-trip assignment for single car dispatching

4.1.1 High-Level: Passenger-to-Car Assignment

The high-level decision variable is the passenger-to-car assignment, for which the following constraint should be satisfied.

1. Passenger-to-Car Assignment Constraints (Each passenger must be assigned to one and only one car)

4.1.2 Low-Level: Single Car Dispatching

The low-level is to solve for each car the single car dispatching problem, which is in essence to determine the service sequence (i.e., loading/unloading) of all the passengers assigned to the same car. The definition of the low-level decision variables, a concept "trip" is introduced to describe the car movement in a single direction (i.e., up or down). Then, the entire car trajectory can be divided into multiple trips in which passengers are sequentially served. It is assumed that an elevator will not change its directions until all the passengers inside are transported to their destinations. The following constraints should be satisfied for the low level decision variable.

1. Passenger-to-Trip Assignment Constraints (Each passenger must be assigned to one and only one trip)
2. Same Direction Constraints (the passengers assigned to the same trip must travel in the same direction.)
3. Capacity Constraints (At any time, the number of passengers in the car must be less than or equal to the capacity of the car.)

4.2 Solution Methodology

A two-level optimization framework is developed here. Optimizing single car dispatching at the low-level and optimizing passenger-to-car assignment at the high-level is done. At the low-level, an effective trip-based heuristic is introduced to optimize the single car dispatching problems for individual cars. At the high-level, a hybrid nested partitions and genetic algorithm method is developed to optimize passenger-to-car assignment.

4.2.1 Two-Level Optimization Framework

The original problem is formulated by a two-level optimization framework. The low-level optimizes the single car dispatching problems for individual cars and provide the optimized performance to the high-level for the calculation of the objective function value. Based on the evaluation from the low-level, the high-level is then to optimize passenger-to-car assignment[12].

4.2.2 Low-Level: Optimizing Single Car Dispatching

To effectively solve the single car dispatching problem, a trip-based heuristic is developed to sequentially decide passengers to be served in each trip.

4.2.3 High-Level: Optimizing Passenger-to-Car Assignment

The high level is to optimize the passenger-

to-car assignment by using nested partitions (NPs) which has been proved to be powerful for many difficult optimization problems. This method is simple and robust. The following are used to perform the high level optimization[13].

1. Traditional Nested Partitions Method
2. Nested Partitions and Genetic Algorithm Method

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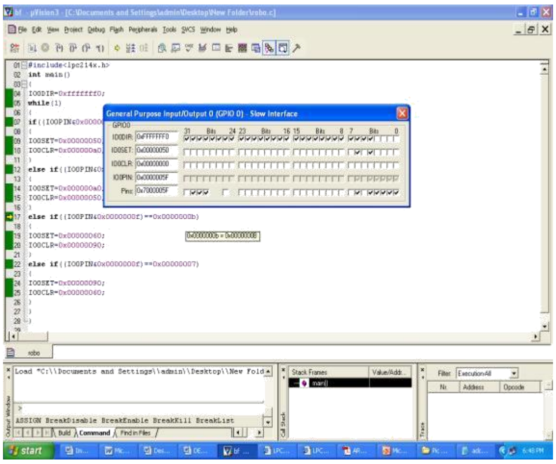
V. RESULTS AND DISCUSSIONS

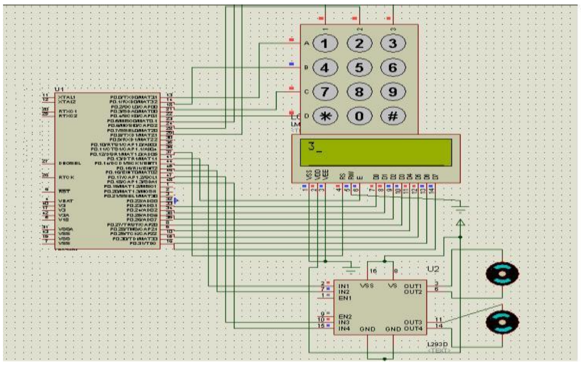
5.1 Screen Shots



5.2 Advantages

1. Power Consumption is less
2. Travelling and waiting time reduced
3. Regulated allotment of the passengers thus reduced traffic

5.3 Output Screen



5.4 Applications

Elevators have become indispensible for life nowadays. It is used almost in every multi-storey building including,

1. Multi National Companies
2. Colleges
3. Hospitals
4. Shopping complex
5. Apartments
6. Defense areas

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5.5 Future Enhancements

A series of experiments have been done to check the good performance of the system in several aspects of interest. It has been a step-by-step procedure, based on the study objectives. The waiting time is greatly reduced by the passenger to car assignment and reaching the destination with ease is achieved. Further, reduction in the door dwell time is being worked on to increase the flexibility of the elevators. In the future reduction in the CPU time may lead to very efficient group elevator system[14].

VI. CONCLUSION

One important trend to improve elevator systems is to use advance traffic information. A two-level formulation is presented in this paper, with detailed car dynamics embedded in simulation models for performance evaluation. In view of the hierarchy structure of this problem, the two-level optimization framework is developed, i.e., optimizing single car dispatching at the low-level with an effective trip-based heuristic, and optimizing passenger-to-car assignment at the high-level with a novel hybrid nested partitions and genetic algorithm method which can be extended to solve certain class of sequential decision problems. Numerical results demonstrate the near-optimality of solutions, computational efficiency, and values of advance information and new features of the hybrid method. The implementation of the emergency mode makes evacuation easy during accidents thus saving lives. This Group Elevator System reduces passenger waiting time and travelling time considerably yielding higher efficiency.

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