

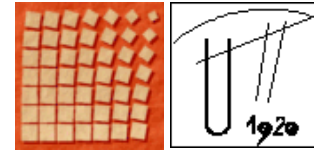
LEEFT3: Lift (Elevator) Environment Forged Tenderly by the Team of Timisoara

Interim Report

**Victor Tomescu
Mihai Zilahi – Stoiculescu
Mihai Martalogu
Zoltan Lorincz**

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1 Project Objectives

This project that is the object of the “Hard & Soft” International Contest 2005 has 3 main goals:

- To implement the controller of an elevator using a “pure” hardware solution. The control algorithm will be implemented on the PIC microcontroller, the drive motor, the cage and floor buttons will be also implemented in hardware. However some actuators and indicators signals will be interpreted and displayed on the computer display.
- To implement a GUI driven simulation of the system described above. This will be a “pure” software solution that will use an environment created in Visual C++ 6.0 in order to simulate the movement of the elevator and the algorithm being used.
- To implement a third solution for the elevator system. This solution will implement some new characteristics like multiple lift shafts controlled by a central dispatcher. It will be a hybrid solution consisting of simulating two elevators: one will be a GUI driven simulation, the other will be implemented in hardware.

2 Design and Implementation Details

2.1 Project 1 – Hardware

This solution implements only one lift shaft. The shaft has 4 floors: ground floor and three others. Each floor has:

- Two buttons used for calling the elevator for going up or down;
- Sensors used to detect the presence of the cage;

The cage of the elevator contains a 7-segment display showing the current floor number. The cage buttons are implemented using a 12 contacts keypad. A system will be implemented for the detection of the presence of the passenger inside the cage.

A scale model of an elevator is being built using a DC motor. The motor is controlled by the hardware board according to the commands received from the keypad and the floor buttons, based on a planning algorithm developed for the PIC microcontroller.

The DC motor is controlled by the PIC microcontroller using just 2 lines: one for speed and one for direction. In order to do this, a simple H – Bridge has been implemented in order to isolate the microcontroller from the large currents that are necessary to the DC motor when working under payload.

The DC motor has at two speeds: half-speed and full-speed. This feature was introduced to make the passengers of the lift car more comfortable and to avoid various unpleasant accelerations. This feature is implemented by using the PWM capabilities of the PIC microcontroller.

Although the scale model has only 4 floors the algorithm used to implement the controller of the elevator has been designed to work with an unbounded number of floors.

A simple description of the algorithm of the elevator controller would be:

- The passengers press one of the floor buttons on each floor to choose the direction they will go: up or down;
- Given any direction of movement for the elevator (up or down) the elevator will serve the request that is closest to him in the direction if it's movement by stopping at the floor the request was made on;
- The elevator will stop at the next floor to satisfy the internal request (the floor number press by the passengers once inside the lift) that is closest to his current position in the direction of it's movement.

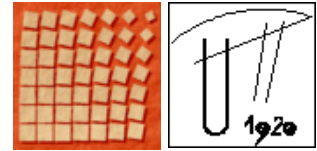
The majority of the outputs are simulated by the PIC microcontroller by sending the desired values on a RS232 interface to PC system. The PC runs an application that has the capacity to interact with the serial port. This application listens on the serial port for any incoming sets of data, retrieve the sent data, parse it and display the results on the GUI.

2.2 Project 2 – Software

This solution is similar to the solution presented above with respect to the algorithms used, but it is a GUI driven simulation. This means that all the actuators, indicators, buttons, sensors, 4 floors and the cage will be simulated inside an environment developed in Visual C++ 6.0.

An additional feature of the current solution is the vocal announcement system for the passengers inside the cage.

The demo for this solution is developed based on a client/server architecture. A server implements the shaft and the cage. The clients implement the individual floors. Each different application runs on a different computer connected together in an Ethernet network. The communication between the server application and the client applications is based on the TCP/IP protocols.



This software solution is developed in Visual C++ 6.0 and the GUI is designed in order to comply with the way an actual elevator keypad looks like. For this reason non rectangular buttons are used inside dialog based applications that will incorporate the client application and the server application.

2.3 Project 3 – Hybrid

This solution introduces the idea of multiple elevator shafts. Only two shafts are implemented: one is implemented in hardware, the other one is simulated on a computer.

The whole system is controlled from a centralized location that is called a dispatcher. This dispatcher receives the messages from both shafts' individual controllers, and based on a special planning algorithm sends back the necessary commands.

Also, the dispatcher has “supreme” powers on deciding how the lift will move. This means that in case of an emergency (a fire, an earthquake) the dispatcher automatically directs both elevators to the emergency floor (ground floor, parking, etc.).

In case of such emergencies the supervisor using the dispatcher can manually override any decisions made by the application and direct any or both lifts to the desired location.

From an algorithmic point of view the two elevators are strictly connected. Although they are not linked in any physical way, the two elevators will work in tandem. If one of the elevators moves, the other one will move in the other direction. This method increases the power consumption of the general system, but is used for a much better planning of the way the elevators satisfy the requests of the passengers.

This algorithm is very efficient when connected to a state-of-the-art idea: the floor number keypads are removed from the interior of the elevator cage and placed on each floor instead of the usual elevator calling buttons (for going up or down).

The passengers arrive at the elevator door and choose the floor they want to go. The dispatcher will then plan their route accordingly retrieving information from the direction the passenger is going, the direction the lifts are moving, the closest elevator to the calling passenger.

3 Intended Deliverables

Project 1 – Hardware

The intended deliverables for this sub-project are as follows:

- Controller board;
- Working elevator scale model.

Project 2 – Software

The intended deliverables for the “pure” software sub-project are as follows:

- Commented source code for the server application;
- Server application;
- Commented source code for the client application;
- Client application;
- Demo application.

Project 3 – Hybrid

The intended deliverables for this sub-project are as follows:

- Commented source code for the dispatcher application;
- Dispatcher application;
- Commented source code for the simulated elevator shaft application;
- Elevator shaft simulation;
- Working elevator scale model;
- Controller board for the hardware shaft.

Other deliverables

Other deliverables for the whole project are:

- Design outline;
- Interim report;
- Final report;
- PowerPoint presentation.

4 Project Tracking and Progress

Achievements. Milestone evaluation

Monday, 16 May 2005:

- Research (elevator architecture, operation diagrams, main functional components and requirements);
- Preliminary design for the elevator controller algorithm;
- Requirement Specification Statement for the three projects (elevator versions);
- Outline design document;

Tuesday, 17 May 2005:

- Detail requirements specification for the first and second projects (hardware and GUI software versions) → *Milestone 1 reached*;
- Implementation of the algorithm for the first project in PIC microcontroller assembly language;
- Implementation of the algorithm for the second project in Visual C++;
- Implementation of the GUI component of the second project in Visual C++;
- Testing of the second project;
- Preliminary construction of the scaled model;
- Construction of the H Bridge for controlling the DC motor;

Wednesday, 18 May 2005:

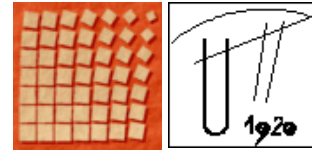
- Controller board for Project 1 – Hardware (PIC microcontroller, keypad, pushbuttons);
- Client application for Project 2 – Software;
- Server application for Project 2 – Software;
- Demo application for Project 2 – Software;
- Working scaled model of an elevator system → *Milestone 2 reached*;
- Interim report document;

Current Tasks

- Implementation of the algorithm for the third project (the hybrid solution);

Next Tasks

- Dispatcher application of the third project (the hybrid solution);
- Application that simulates the second elevator for the third project;
- Final report document;
- PowerPoint Presentation;



References

- [1] Jim Brown, "Brief H-Bridge Theory of Operation", April 1998, online:
<http://www.dprg.org/tutorials/1998-04a/>
- [2] Scott Edwards, "Electronic Control for DC Motors Using Discrete Bridge Circuits", January 1997, online:
<http://www.parallax.com/dl/docs/cpls/nv/vol1/col/nv23.pdf>
- [3] Dr. Albert T.P. So, S.K. Liu, "An Overall Review of Advanced Elevator Technologies", June 1996, online: <http://www.elevator-world.com/magazine/archive01/9606-001.htm>
- [4] LockerGnome Encyclopedia, "Elevator. Everything you wanted to know about Elevator but had no clue how to find it". online
<http://encyclopedia.lockergnome.com/s/b/Elevator>
- [5] Dan Stixrud, 'Dan's "Canned Mouse"', sections: "Optical Xmtrs", "Optical detectors", "Schematic" online :
<http://www.amsky.com/atm/accessories/mouse/mouse.html>
- [6] Microchip, Inc., "C sample code for PIC micros and Hi-Tech C", online:
<http://www.microchip.com/sourcecode/>
- [7] Circuit Exchange International, "DC Motor Control Circuit" online:
<http://www.mitedu.freereserve.co.uk/Circuits/Switching/dcmotor.html>