ELEVATOR MODEL USING MC68HC11

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ABSTRACT

Lift or elevator is transport device that is used to move goods or people vertically. In this project, the MC68CH11 based lift control system is developed to simulate as a real elevator. There are two major modules which are microcontroller module and interface circuit module. Interface circuit module consists of dot-matrix, 7-segment, stepper motor, speech IC and buzzer. Dot-matrix and 7-segment are used as display mechanism to indicate the level floor while speech IC will notify the current position of elevator. It provides useful information to those who wish to carry out a lift control system research or project.

ABSTRAK

Lif ialah pengangkutan yang digunakan untuk membawa manusia atau barang dari satu tingkat ke tingkat yang lain untuk sesuatu bangunan. Satu model berasaskan pengawal MC68HC11 dibangunkan untuk mensimulasikan sistem sebenar lif. Terdapat dua modul utama dalam pembinaan sistem ini iaitu modul mikropengawal dan modul litar antaramuka. Modul litar antaramuka terdiri daripada modul dot matriks, paparan 7 ruas, motor pelangkah, modul pemain suara dan penjana nada. Dot matriks dan 7 ruas digunakan sebagai alat paparan bagi menunjukkan aras lif manakala alat pertuturan memberitahu keadaan semasa lif. Model ini menawarkan maklumat yang berfaedah untuk mereka yang mahu membuat kajian atau projek berkaitan dengan sistem kawalan.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The advancement of computer technology demands the needs of this machine in almost all electronic devices either in consumer product or military equipment or industrial automation or even in household appliances. The usage of this machine is further promoted by drastically decreases cost of semiconductor and the fast growth of Ultra-Large Scale Integration (ULSI) technology. It is expected in the near future all the electronics equipment will be controlled by computer in their hardware design.

In general, the computer is defined as an electronic machine that performs *arithmetic operation* and *logic* in response to instructions. The computer requires ***hardware*** and ***software*** to perform its task. Hardware is electronic circuit board that provides functionality of the system. While, software is a programming or a set of instruction that controls the system operation and facilitates the computer usage.

As shown in Figure 1.1, the hardware of computer systems consists of Central Processing Unit (CPU), Memory and input/output (I/O) device. The CPU consists of 3 components that are Register, Arithmetic Logic Unit (ALU) and Control Unit. Memory, on the other hand, is a storage device in microcomputer. The instruction and data are stored in binary format. In similar manner, I/O devices allow the computer to communicate with the outside world. The examples of I/O devices are monitor, tape, CD-ROM, keyboard and etc. **[1]**

There are various types of computers. They are microcomputer, workstation, mainframe, supercomputer, PDA, pocket PC and microcontroller. Of late, microcontroller plays significant role in many electronic products such as automotive, military equipment, wireless communication, security system and etc.

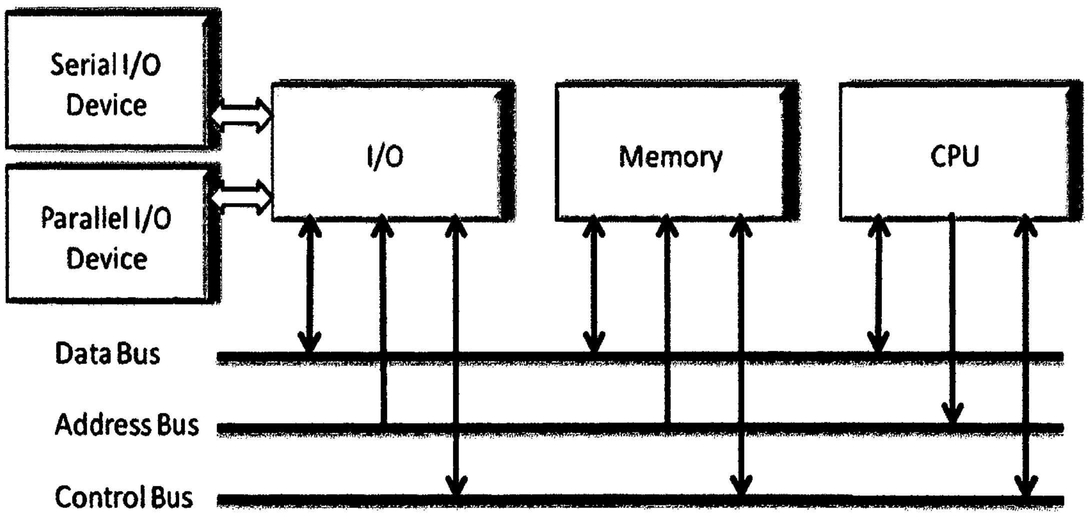

Figure 1.1 Block Diagram of Basic Computer System

Microcontroller is a single-chip computer that contains memory for program information and data. It also has CPU to read inputs, manipulate data, and send outputs through output devices. Unlike microcontroller, the microprocessor contains no ROM, RAM, I/O on the chip itself and requires these devices externally to make them function.**[2]**

Microcontroller is developed from *microprocessor*. The first microprocessor, Intel 4004 produced during year 1971. It contained 2250 transistors and handled binary data as 4-bit words. Later, Intel introduced 8008 where an 8-bit device that incorporated other advanced features. A larger bit size means that a microprocessor can process more data. The most common microprocessors were the Intel 8080, 8085. Motorola 6800, Signetics 6502, Zilog Z80 and the Texas Instruments 9900.**[2]**

Generally, microprocessors are evolving in two directions, performance and integration. The general public is well aware of the former type of microprocessors because of its popularity in personal computers. Table 1.1 shows the comparison between microcontroller and microprocessor. One of the most popular 8-bit microcontrollers is MC68HC11.

M68HC11 was developed by Motorola Inc. in 1985. It is upwardly compatible with 6800-type microprocessors and offers extra features. The 68HC11 uses high-density complementary metal-oxide semiconductor (HCMOS) technology. Some commercial products which controlled by 68HC11 are CD player, washing machine, intercom, telephones, security systems applications and etc. Due to its flexibility and versatility, this controller is chosen in design an elevator model system.

Table 1.1 Microcontrollers versus Microprocessor

MICROCONTROLLER	MICROPROCESSOR
- High integration with small space for PCB - Limited expansion - Cheap - Special architecture - Low power consumption - More reliable due to less connection - Easy for trouble-shooting - Simplicity	- High performance - Flexible and can easily be expanded - Expensive as it requires more ICs - Large space

1.2 Project Objective

The objective of the project is to design an elevator model using MC68HC11 as its controller. Model is an important concept in any product designs as it is a first step in realizing the design toward its commercialization. By develop a model, it helps to simulate, analyze, explore and refine before the design is manufactured. The feedback on features from potential customer through the model will cause the product to be more attractive.

In general, the 3-level elevator consists of typical real-time elevator such as speech device, dot matrix, 7-segment and stepper motor. The input, on the other hand, consists of a multiple RESET switch to be used by the user for floor selection.

1.3 Project Scope

In order to realize the objectives of the project, the scopes of the project are simplified and summarized as following;

- Design and develop microcontroller system to control the operation of the model.
- Design and control the sequence of motor that is used to control the movement of the elevator car.
- Construct and build the output display modules such as dot matrix and 7-segment to display the status and condition of elevator car.
- Design and construct the speech module to inform the status of elevator car that be useful to handicapped people and more importantly create user-friendly environment.
- Develop overall elevator systems according to the real elevator traffic algorithm by using Finite State Machine (FSM).

1.4 Thesis Outline

The thesis is divided into 6 chapters. Each chapter emphasizes on the specific topics related to the project. The following synopsis summarizes the aspects that will be discussed in each chapter;

Chapter 1 introduces the development of microcontroller, project objective, project scope and the description of the project.

Chapter 2 describes the overview of the project. The block diagram of the project is illustrated in the chapter. A simple elevator service algorithm of the elevator controller system is also explained in the chapter by using FSM approach.

Chapter 3 illustrates the hardware design of the system. It includes microcontroller system and interfacing system such as stepper motor module, speech device module, dot-matrix and 7-segment module, and emergency module.

Chapter 4 concentrates on software development. The software is developed using assembly language. The system management algorithm using flow charts are also illustrated in the chapter.

Chapter 5 discusses the process of implementation the module in the elevator model system. Each module is designed, constructed and tested independently. This chapter elaborates the process result of each module. The efforts that had been taken to solve in the problems are also briefed in the chapter.

Chapter 6 concludes the achievement of the project. Some suggestions of the project are discussed for further development. Overall calculation of budget is also attached in this chapter.

CHAPTER 2

SYSTEM ARCHITECTURE

2.1 Overview of Project

Figure 2.1 shows the block diagram of an elevator system model. The model consists of 7 modules which are;

- Microcontroller Module
- Stepper Motor Module
- Speech Device Module
- Dot-Matrix Module
- 7-Segment Module
- Miscellaneous module

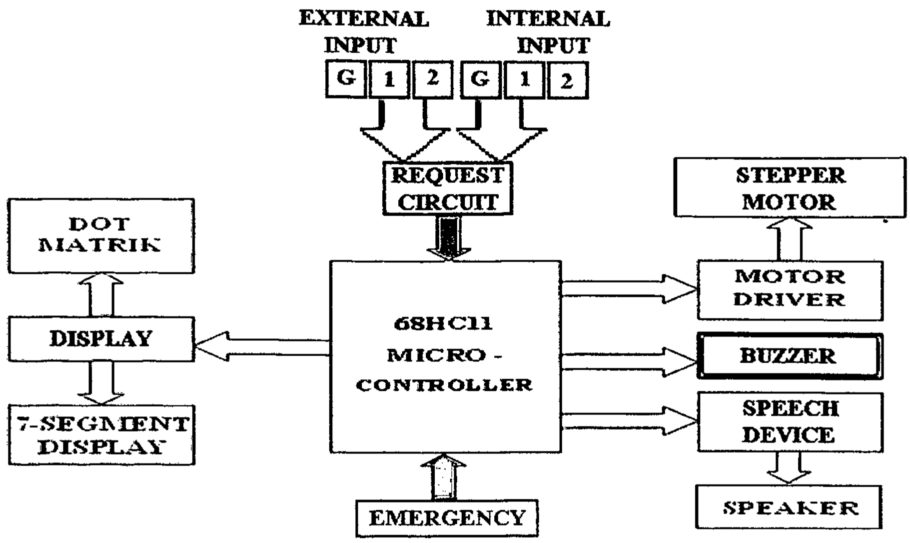

Figure 2.1 Block Diagram of an Elevator Model System Using MC68HC11A1

2.2 Microcontroller Module

In general, this project uses microcontroller as the main controller system. There are various types of microcontrollers available these days. Each offers various features in term of operation, memory size or port allocation. Since the design is simple, the 8-bit microcontroller is considered. Nevertheless, the microcontroller may require external I/O port as the system consists of multiple I/O devices.

For this reason, M68HC11 is chosen due to its capability to extend the memory and I/O port. In addition, the microcontroller uses Von Neuman architecture so that, its programming language is simple. Figure 2.2 shows a simple block diagram of microcontroller system.

As shown in the Figure 2.2, M68HC11 consists of 5 port that are Port A, Port B, Port C, Port D and Port E. However, due to expanded mode operation, Port B and Port C are no longer available as they are used for address and data bus respectively.

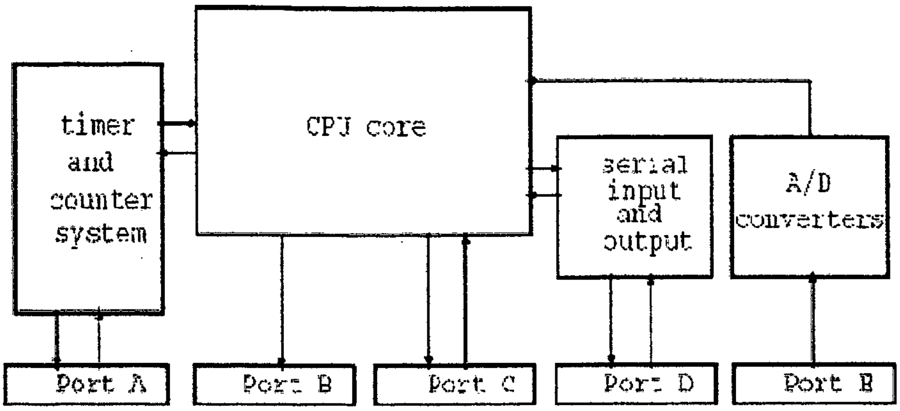

Figure 2.2 Microprocessor Structure

2.3 Input/Output (I/O) Modules

The model requires several I/O modules. They are;

- Stepper motor module
- Speech device module
- Dot-matrix module
- 7-segment module
- Miscellaneous module

2.3.1 Stepper Motor Module

There are various forms of motor that can be used to move the elevator car. They include DC motor, servo motor and stepper motor. However, in this case stepper motor is chosen. In general, stepper motor is widely used devices that convert electrical pulses into mechanical movement. It is commonly used in disk drives, dot matrix printer and robotics. Each stepper motor has a permanent magnet rotor (shaft) surrounded by a stator. The most common has 4 stator windings that are paired with a centre tapped common which allows a change of current direction and resulting a change of movement.

To make the stepper move for each step, a sequence code must be placed at each point. Unlike DC motor, the stepper move in fixed repeatable increment which allows one to move it to a precise position. The angle of movement can be 0.72°-15°. For 15° angle, one complete revolution requires 24 steps. Similarly, for a 7.5° stepper motor, a complete revolution needs 48 steps. Figure 2.3 is an example of stepper motor.

Some of the advantages stepper motor are summarized as follow;

- Allows a precise position control
- The motor can be controlled in close or open loop without the need of sensor for feedback position
- The motor provide a simple programming.

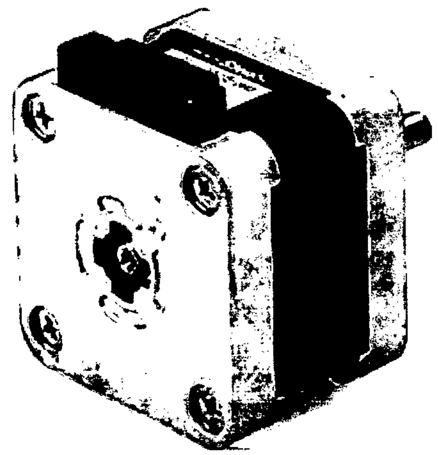

Figure 2.3 Stepper Motor Type 103H5208-0440

2.3.2 Speech Device Module

Information Storage Devices are one of the best in solid state audio recording and playback devices. Recording audio stores in on-chip nonvolatile memory cells provides zero-power message storage. The ISD2590 series provides high quality, single chip solution, solid-state voice reproduction which stored voice and audio signals directly into memory in natural form. Figure 2.4 shows the block diagram of ISD2590 series. The detailed of this ISD2590 Chip-Corder® is available in Appendix A.

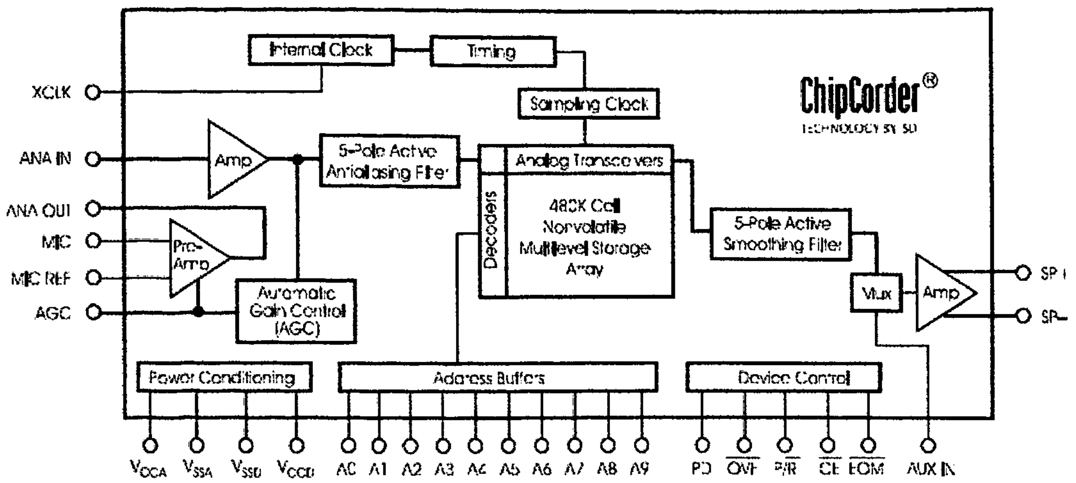

Figure 2.4 ISD2590 Block Diagram

Table 2.1 shows various versions of the ISD2500 series. In general, digits precede 5 represents the speech duration. For example, ISD2590 represents 90 seconds recording. However, as the duration of the speech storage is increased the sampling frequency is decreased. This of course deteriorates the sound quality produced. The speeches are stored directly into the chip without the digitization and compression associated with other solutions. The message is retained for up to 100-years without power. In addition, the device can be re-recorded typically over 100 000 times. Details of *recording/playback* will be discussed in Chapter 3.

Table 2.1 ISD2560/75/90/120 Product Summary

Part Number	Duration (Seconds)	Input Sample Rate (KHz)	Typical Filter Pass Band (KHz)
ISD2560	60	8.0	3.4
ISD2575	75	6.4	2.7
ISD2590	90	5.3	2.3
ISD25120	120	4.0	1.7

2.3.3 Dot-Matrix module

Lately, dot matrix has been widely used in various applications to display text, graphical, animation and etc. These dot matrixes usually are used in advertisement board, in elevator, index share holder display and etc. There are different sizes of dot matrix such as 5 x 7 dot matrix and 8x8 dot matrix with different color such as single color, bicolor or tri-color. The 8x8 dot matrix display contains 64 LED arranged in a matrix of 8 rows of LEDs with each row containing 8 LEDs. The concept of scanning display is required in dot matrix display. Only one column is displayed at a time and the eye merges together to get the 'image' that displayed. It is generally operates at higher rate than 100 scans per second where the eye sees the displays are fixed. However, the individual column can be seen if the scan rate is reduced.

The process of display begins with data sent to the dot matrix. The selected column is activated and the short delay is called between each data that have been sent. The process is continued until the last column is activated. In elevator model, 1.20" x 1.20" size of 8 x 8 dot matrix display is used as an indicator to display elevator. Figure 2.5 shows the basic structure of dot matrix display.