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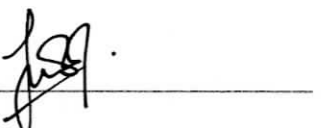
Signature : 

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THE DESIGN OF SMART BATTERY CHARGER WITH DISPLAY

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This Report is Submitted In Partial Fulfillment Of Requirements For The Bachelor Degree Of Electronic Engineering (Industrial Electronic).

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
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March 2005

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Dedicated to my beloved family especially my mother and father

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ABSTRACT

This project proposes to build a prototype of an automatic battery charger better than the battery charger in the current market. Nowadays, battery has been the most important product to be used in the portable product. The new battery needs the tickle-charge features to extend it life span. The normal chargers do not have these features. This battery charger projects have display, sensor, timer and discharging function for the NiCd (Nickel Cadmium) and the tickle charge for the NiMH (Nickel Metal Hydrate) battery. This project consists of 7 parts. There are the power supply, display, current switching, cell selector, temperature sensor, discharge switch and the charger controller. This smart charger battery is suitable for commercial use because of it low cost budget. The charger can give the battery a longer life span and prevent it from overcharging or leaking. A specific integrated circuit shall be use in the circuit as a charger controller to get the best result in the charger timing and controlling. This project is able to charge the NiCd and the NiMH battery with display to show the current charging status and have the timer to give it a longer life span battery. It also features with the charging rate selection to suite the best result for a certain standard of batteries. The charger also is able to cut the charging time to 4 hours only.

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ABSTRAK

Projek ini bertujuan untuk membina sebuah prototaip pengecas bateri automatik yang lebih baik dari pengecas bateri yang ada di pasaran. Masa kini, bateri telah menjadi salah satu daripada produk yang penting digunakan dalam produk mudah alih. Pengecas bateri baru memerlukan kelebihan cas-detik untuk memanjangkan jangkahayat bateri dimana pengecas bateri biasa tidak mempunyai kelebihan ini. Projek ini ialah pengecas bateri yang mempunyai paparan, pemasa, dan fungsi discas untuk bateri NiCd (Nickel Cadmium) dan cas-detik untuk bateri NiMH (Nickel Metal Hydrate) . Projek ini terbahagi kepada 7 bahagian. Ia adalah bekalan kuasa , pengawal arus pengensuisan, pemilih sel, pengesan suhu, suis discas dan pengawal pengecas. Pengecas bateri bijak ini sesuai untuk kegunaan komersil kerana kos yang rendah. Pengecas ini boleh memanjangkan jangkahayat bateri dan mengelakkan daripada "terlebih-cas" dan "bocor". Satu litar terkamil digunakan dalam litar sebagai pengawal pengecas untuk mendapatkan penyelesaian yang terbaik dalam pemasaan pengecasan dan tujuan pengawalan. Hasil daripada projek ini dapat mengecas bateri NiCd dan NiMH dan mempunyai paparan untuk memaparkan status semasa serta mempunyai pemasa untuk mengira masa pengecasan untuk memanjangkan jangkahayat bateri. Ia juga mempunyai kelebihan untuk memilih kadar pengecasan yang sesuai mengikut piawaian bateri.Pengecas ini juga dapat menjimatkan masa pengecasan kepada 4 jam sahaja.

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ABREVIATION

PCB	-	Printed Circuit Board
NiMH	-	Nickel Metal Hydrate
NiCd	-	Nickel Cadmium
LCD	-	Liquid Crystal Display
Hex	-	Hexadecimal
LED	-	Light Emitting Diode
AC	-	Alternating Current
DC	-	Direct Current
TTL	-	Transistor – Transistor Logic
PIC	-	Peripheral Interface Controller
I/O	-	Input / Output
PC	-	Personal Computer

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

This smart battery charger with display is a project which will consist of a display and a discharge function for the NiCd (Nickel Cadmium) battery type and also "pulse tickle-charge" for the NiMH (Nickel Metal Hydrate) type battery. This battery charger is divided into 7 main parts, which are the power supply, switching current control, cell selector, temperature sensor, discharge switch, and charging control. This charger is capable of extending the lifespan of the battery and prevents it from over-charging and current-leakage. An integrated circuit for the charging control is used in obtaining the best solution for the charging-time and also for the control purpose. This project also has the advantages of having the option in choosing the charging rate, accordingly to the Battery Standard.

Nowadays, there are many type of the charger in the market. The problem encountered with standard charger is it does not have an automatic "on" and "off" function when the charging process completed. It also do not have display to indicate the current process done to the battery, no discharge functions for the NiCd and no sensor to detect the battery temperature. The charging phases is also not very stable for most of the charger.

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After completing the research regarding the charger in the market, the standard or basic phase of battery charging is stated in the graph below. It has 3 phases where the starting phase called Phase 0 that is the battery qualification stage. In this stage, the battery condition whether it can be charge and type of the battery is determined. On the Phase 1, the battery is charge with the maximum current. Finally, on the Phase 2 the "fast charge" activated. In this phase, the voltage is in maximum level.

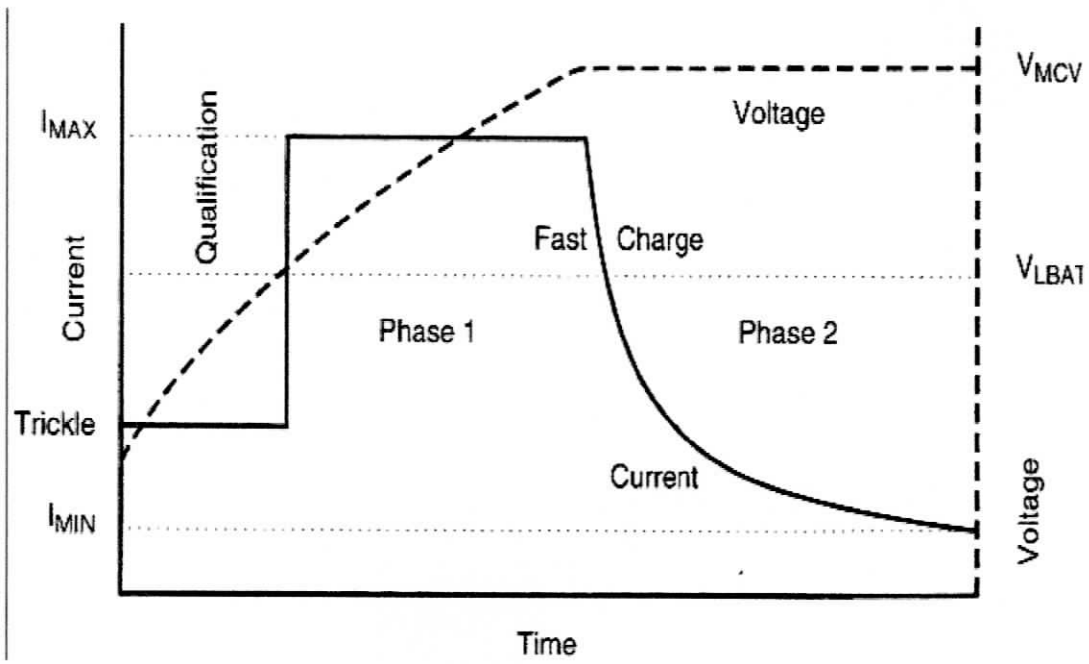

Figure 1.1: Graph of the standard charging phases.

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The process of charging also can be represented in state-diagram from the power supply circuit to the pulse tickle charge circuit like below:

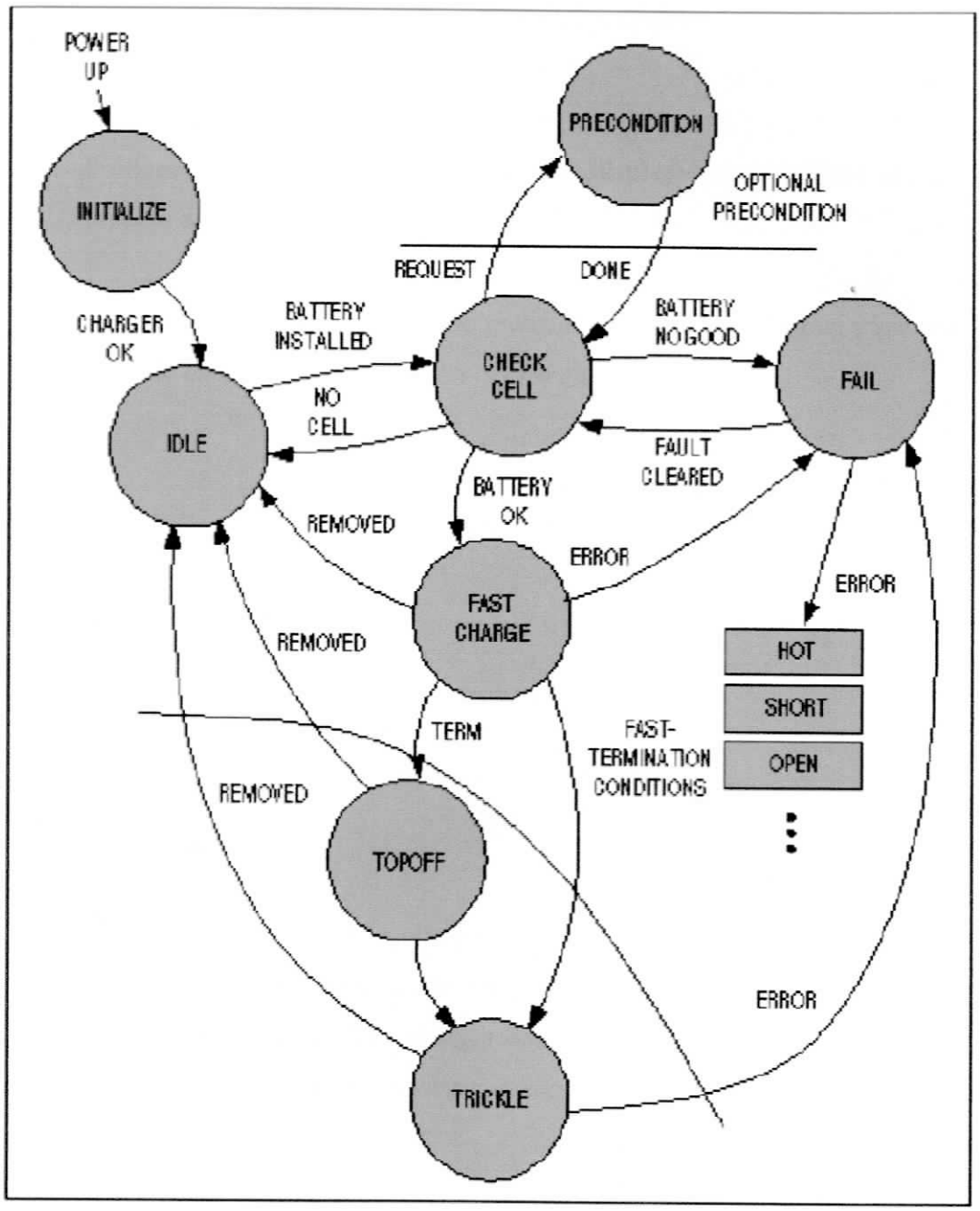

Figure 1.2: Charging-state diagram

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1.2 OBJECTIVE

The objectives of this project are specified as below:

1. Produce Automatic battery charger with display which indicate the current process done to the battery.

2. To learn the characteristic of the rechargeable battery, charging condition for specific battery and the function of charging controller IC.

3. To gain knowledge in PIC microcontroller and circuit design.

1.3 PROJECT SCOPE

The project is specific to charge Nickel Metal Hydrate (NiMH) and Nickel Cadmium (NiCd) type of battery. The size of the rechargeable battery is AA Size Battery, with 1.2V Voltage. The charger has pulse tickle charge function and has LCD Display to display current process running.

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1.4 PROJECT METHODOLOGY

This project divided into software application and hardware. For software application, compiler software used is The PIC Basic Pro Compiler. The programmer software used is IC-Prog. Microcode Studio used for Code Editor. Simulation software used is Proteus ISIS 6 Professional. It Have a few steps to get the machine code (Hex) for the data to program in the microcontroller that is:-

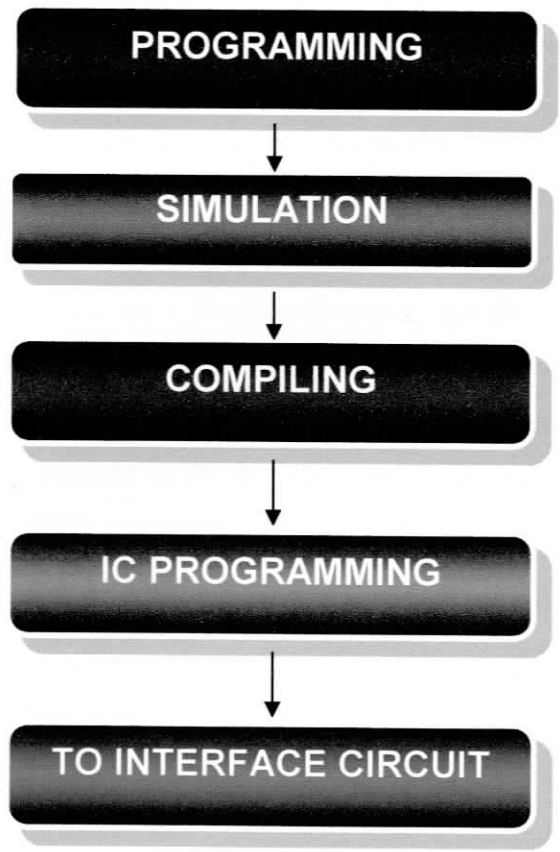

Figure 1.3: PIC microcontroller programming process.

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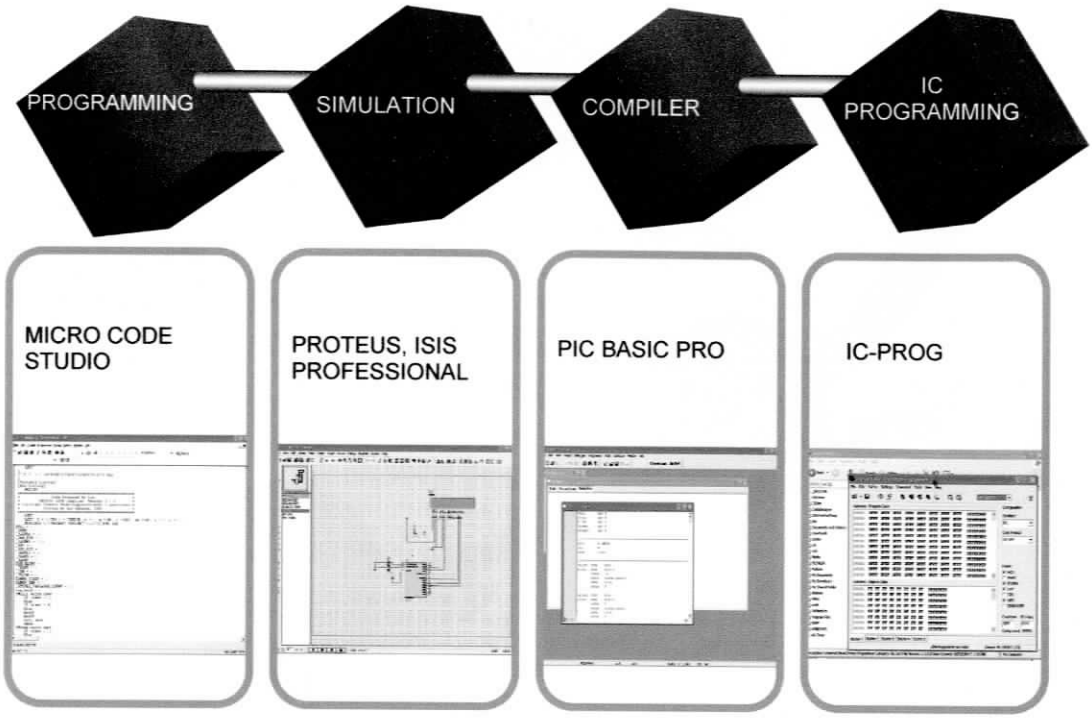

Figure 1.4: Software used with the project

Figure above is the process done with the software to get the .hex file. The hardware used with the project is the PIC microcontroller, this microcontroller design to control the display section. The charging controller IC used is specially design to control the charging process in the project. Liquid Crystal Display is to indicate the current process. JDM programmer; it is used to program the PIC microcontroller data into the FLASH memory.

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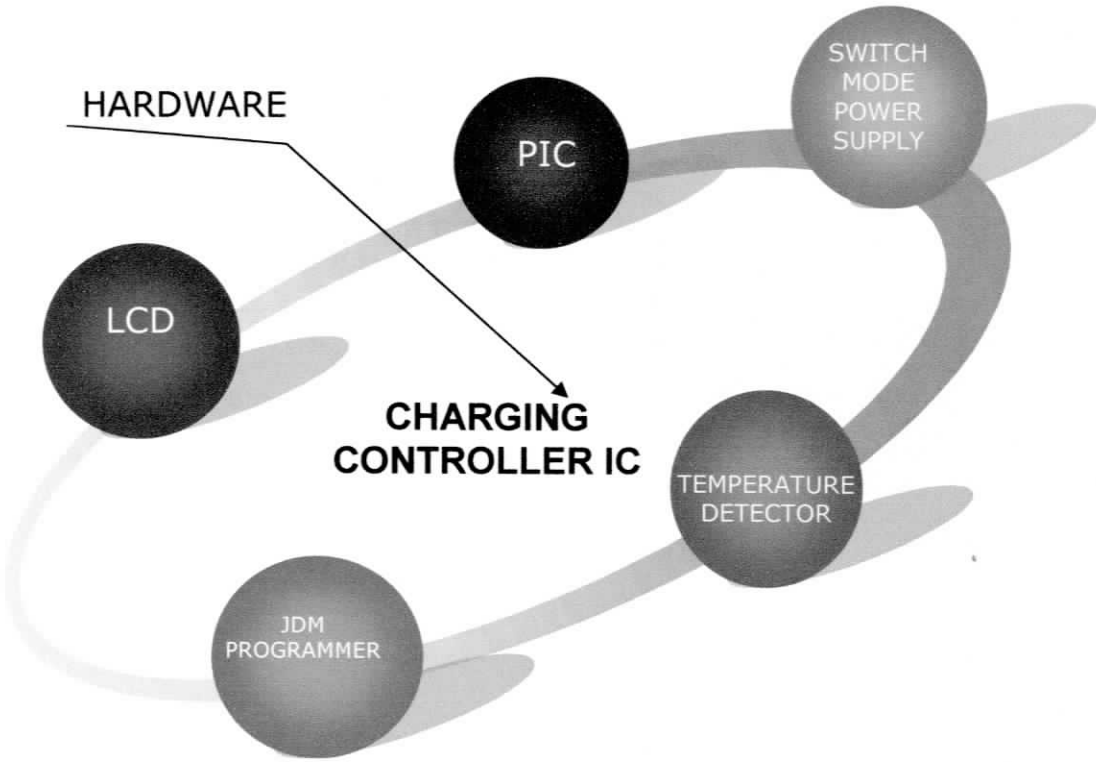

Figure 1.5: Important hardware for the project

Figure above mention a few hardware and component used to produce the project. The procedure of this project starts with the designing of the charger circuit. Then, it followed by the display circuit design. Then, the program for the display circuit created and tested with the simulation software. When the program complies with the entire requirement, then it is downloading to the IC with the JDM programmer. The completed circuit will be constructing on the "Breadboard" to test the circuit working condition. If the entire project test complied with the project specification, the project will proceed to the next stage. Finally, the last stage of the process is to create the construct the circuit on the printed circuit board (PCB).

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