Country Code 21.

DESIGN PROCESS FOR A SEALED LEAD ACID VEHICLE BATTERY CHARGER.

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Abstract

This paper describes a flexible modular design approach applied to the design of a sealed lead acid vehicle battery charger. The design process is separated into sub-processes and the design is then checked against available modules and knowledge. Potentially useful modules are then identified and used if possible. Other new modules are then created to complete the design. New products can be created from available modules if possible and this simplifies the design process and makes the process cheaper.

Key words: design, battery charger, vehicle.

Introduction

This paper describes new modular approaches to flexible design and concurrent engineering. They categorise the process into separate sub-processes and include sub-processes to check available modules and knowledge, select potentially useful modules and identify what new modules need to be created. A sealed lead acid vehicle battery charger was created using the technique to assist the designer.

Some systems such as Computer Aided Process Planning (CAPP) systems have provided assistance to designers during design and have reduced product development lead-time [Tan (2006)]. A limitation of these systems has been that they were designed to model the product and process design as a whole, which made the systems inflexible for expansion when new processes needed to be included.

The new Modular Electronic Design System described here overcomes this problem by modelling product and process design in a number of sub-processes. Intelligence and knowledge from each process were captured. This approach will enable greater flexibility in terms of modifiability, upgradeability, extendibility and reusability.

To demonstrate this new approach, a sealed lead acid vehicle battery charger was created in collaboration with MotionTouch Ltd. New modules were created as required after available modules had been considered. The module selection process considered previously created modules and determined which new modules needed to be created.

Figure 1 shows the structure and methodology for the new Modular Electronics Design System

It consists of the following sub-processes and these are briefly described:

- Module Selection (*to be created*).
- Identification of new modules (*in use*).
- New Modular Circuit Design (*in use*).
- Modular Circuit Prototyping (*in use*).
- Overall System Prototyping (*to be created*).
- PCB Generation(*to be created*).

Module Selection

The Module Selection Expert is yet to be created but will be sued to help designers in selecting modules to make up a product. This will be achieved by logically dividing the whole design into modules. The requirements of more than one of these modules might be met by re-using a module; this thought highlighted the possible opportunities for this to occur. A list of modules which have been selected can be compared to a list of modules which have already been created (and stored). Pre-created modules could then be fetched into the current design.

Identification of new modules

This sub-process evaluated what parts required in the design had not been covered by the selection of existing modules and then determined the number of modules required and the function of each of the new

modules in order to complete the remaining parts of the design. This was achieved by utilising the modular divisions made in the module selection; these divisions were evaluated to confirm that the divisions were reasonable for each to be made as a module, if so then they were used as the basic requirements for the modules to be created.

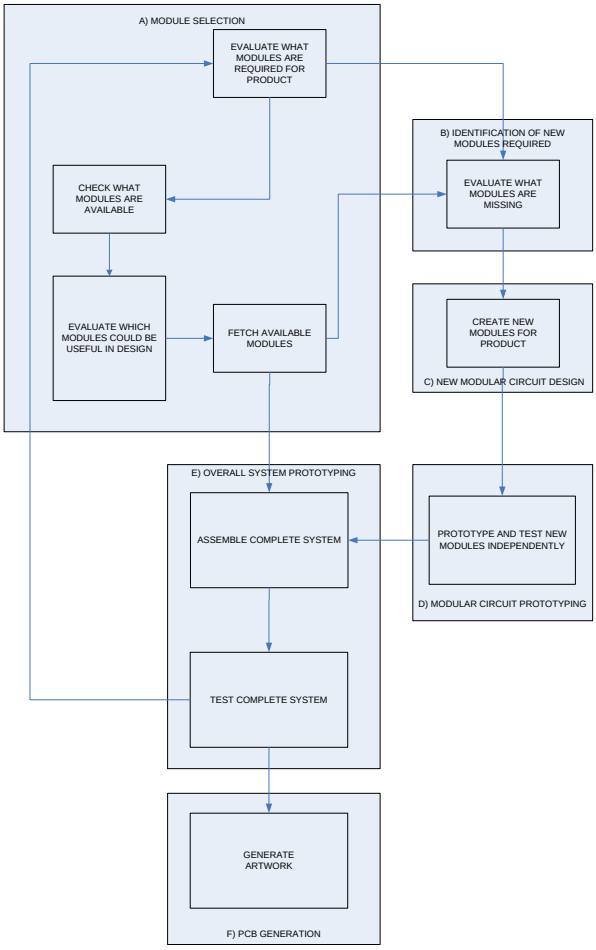

Figure 1: Module Selection.

Modular Circuit Design

RangerXL was used as a CAD package to create the electronic and electrical modules. This system contained support for both hierarchical and flat circuit designs. Using RangerXL with hierarchical circuit designs provided the ability to implement the modular approach and was achieved by fetching the required modules and organising them in the design. This method will also support the creation of individual modules from a collection of other modules therefore facilitating the growth of the knowledge base and the complexity of the modules in the knowledge base.

Modular Circuit Prototyping

Once each of the modules had been designed, then each module was created as a prototype to be tested. Any issues from testing of the prototype module were fed back to Modular Circuit Design; this maintained the reliability and accuracy of the knowledge base and reduced the number of issues in future products created using this system.

Overall System Prototyping

Once a set of modules required to create a complete unit had successfully been prototyped and tested, thenin the future the modules will be available to be integrated into a complete unit. This complete unit will be tested, to confirm that all of the modules in the system continue to perform as designed. Any issues from testing the complete system will be fed back to Modular Circuit Prototyping and then back to Modular Circuit Design. This sequence will ensure that any changes to modules are tested before being integrated into the overall system. This testing will be the second stage to maintaining the accuracy and reliability of the stored modules.

PCB Generation

Once the function of the overall system has been confirmed then a net-list will be generated. which will then be used to generate artwork. The information provided by the net-list will allow the system to place all of the components required for the modular design onto the PCB. Once all the components have been placed on the PCB then tracks can be intelligently routed using an intelligent auto-router. Finally, the manufacturing process can be integrated with the new Modular Electronic Design System.

Work completed

The Modular Electronic Design Process was applied to the design of a battery charger [Reference]. The Prototype Modular Electronic Design System reduced the number of new modules required for a new product, whilst implementing a structured development process for designing products.

At present the modular design system is being applied to a project to create a battery powered solution incorporating GPS, Bluetooth, Touchscreen and a CCD Camera into the same unit which will then provide this functionality to a Blackberry device.

The work will then move on to: the investigation of Integrating the Modular Electronic Design System into different environments.

Individual parts of the modular design system will need to be investigated further to define constraints for the system to ensure each sub-process is performing the correct tasks.

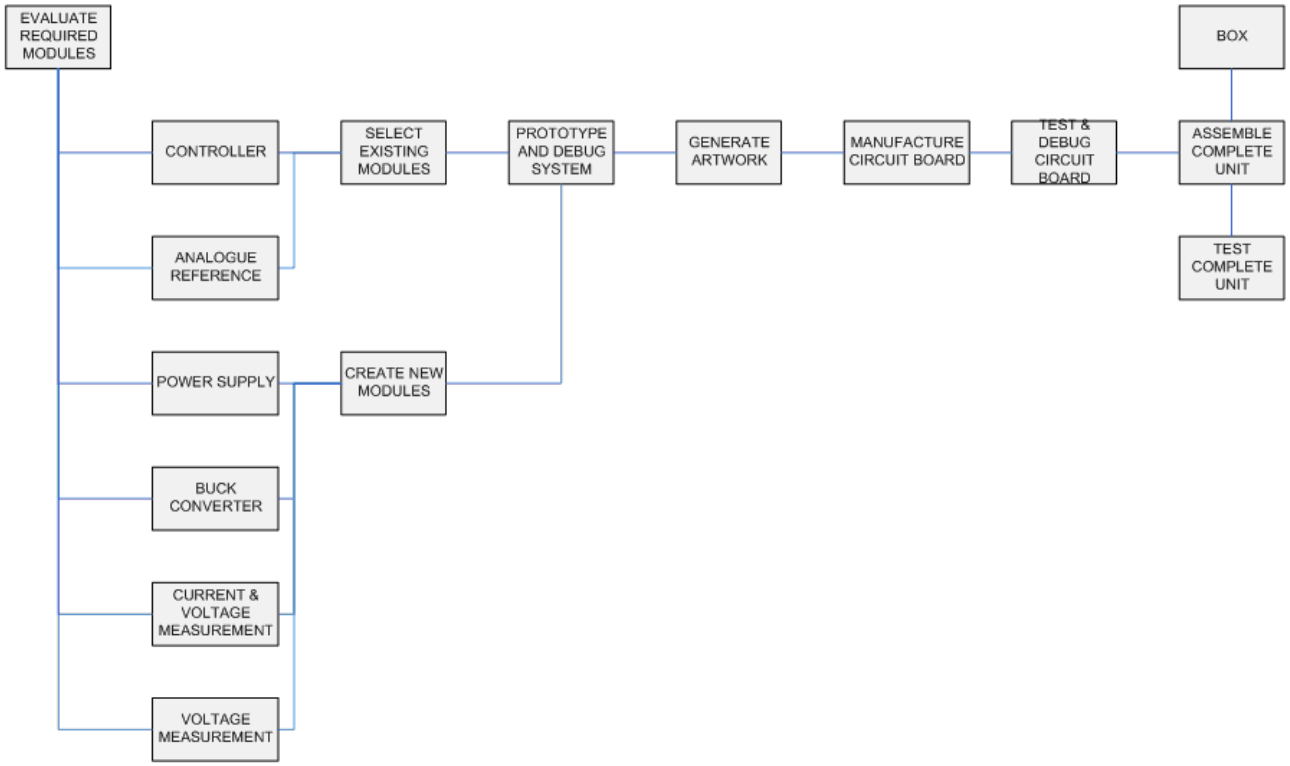

Figure 2 - Sealed Lead Acid Battery Charger design

Once the sub processes have been defined, investigation into the possible Knowledge Management Methods which could be used for the modular design system will lead to a New Modular Electronic Design Structure.

This New Modular Electronic Design Structure will then be implemented to investigate the structure further, with a new System linked with Modular Electronic Design Structure to assist a Designer

Prototype PCBs to demonstrate the new system will be produced.

Conclusion

A first prototype new modular electronic design system has been created and tested. The work will continue to define the sub-processes of the Modular Electronic Design process along with interface standards and constraints for new modules being created. The feasibility of using the Modular Electronic Design System in a programming environment will also be investigated.

The following will be created:

- Modules to be used and re-used to create products.
- Interface Standard for the modular electronic components.
- A first prototype of a product, comprising several modules, for example:
- communications module
- core processor
- Biometric identification device.
- Prototype PCB circuits for at least one module as an example along with firmware and full testing of the module.

The work will investigate the Integration of the Modular Electronic Design System into different environments. The following parts of the modular design system will be defined

- Sub Processes
- Modular Electronic Design Interface Standards
- Modular constraints for new modules
- Different Environments into which the system will be integrated.

References

Tan YC (**2006**). **Multi Expert Concurrent Engineering System to assist a designer**. *PhD Dissertation, Portsmouth University*.