

Design Process For Electronic System

Sanjay Singh Thakur
sanjaysingh.thakur@vit.edu.in

Harshada A. Rajale
harshada.rajale@vit.edu.in
Department of E & TC Engineering, VIT, Mumbai, India

Tejal P. Page
tejal.page@vit.edu.in

Amit R. Maurya
amit.maurya@vit.edu.in

Abstract— Electronic System is a setup of electronic components, devices used in electronics. Large number of topics, which covers analog and digital systems, which is being implemented by using discrete and integrated circuit. Also includes design techniques to cover Electronic Design Automation, authentication, endorsement, and system framework which implements real time embedded systems. Presented paper also includes an example of communication system design emphasizing on structures, characterization and system applications.

Keywords— Electronic System Design, Biometric, fingerprint recognition, proxy prevention, Student attendance system, application

I. INTRODUCTION

Field of electronics is being related to flow of charge of electron through any medium like conductor, semiconductor, vacuum, gas, air, water even through insulator like glass fiber. The history of electronics engineering is as old as human's civilized life. It began with safety and security of the mankind. A set of inputs and outputs form the electronics system comprising of one or many devices/components [1]. They are classified on basis of operations for e.g. communication system, medical electronics, instrumentation, control and computer system. Electronic circuit or system must communicate with an I/O device where the trigger signals are in form of electrical data/signals [1-2]. Electronic systems can also be classified as; Analog Electronics, Digital, Power and Micro Electronics, Communication systems. Electronic systems are, normally, design to perform certain functions. The performance of an electronic system is evaluated in terms of voltage, current, impedance, power, time, frequency and input and output of system. These parameters include transient specifications, distortions, frequency specifications, and DC and small signal specifications [1-3].

The Accreditation Board for Engineering and Technology (ABET) largely expresses engineering design as, "Engineering design is a process of devising a system, component or process to meet desired needs". Design is a decision-making exercise (often with multiple samples) in that the basic sciences, analytical/numerical and engineering sciences are used to modify resources optimally to obtain the stated objective. Among the fundamental elements of design process are the establishments of objectives, criteria, synthesis, analysis, construction, testing and evaluation" [4].

Engineering is all about establishment of devices, processes and systems, which are needed by the society. This is achieved with the help of engineering design. The engineering design component must include the following features; formulation of design problem may be open-ended problem statements and its specifications, improvement of system and application of design concepts and methodology, detailed system description, with concurrent engineering

design, feasibility considerations with alternative solutions. The production process must include number of actual, practical factors such as reliability, safety, ethics, economic factors, social impact and aesthetics.

II. ENGINEERING DESIGN PROCESS

The primary objective of this work is to have an insight of engineering design process. As shown in figure 1, the block diagram of proposed engineering design process [5]. The elements of Engineering Design Process are as follows:

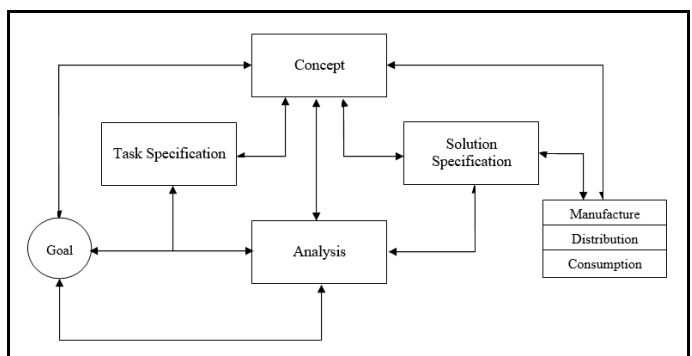


Figure 1: Block diagram of Engineering design process

A. Concept

Concept of obtaining the best results is the ultimate engineering experiment/hypothesis which rise in the beginning as mental image. These are noted initially as line diagrams/flowcharts then successfully validated, polished, systematized and eventually documented by standardized formats. The hypothesis are sometimes preceded or followed by acts of assessment, inferences and verdicts.

B. Goal

A process may be an assertion of the need to fulfil the desire of mankind that is known as goal.

C. Analysis

The procedure of analysing is intermittently instinctive and quality based but more often it is analytical/numerical, quantity based, cautious and unambiguous. In the light of analysis conducted, tasks specifications and even goals may be altered.

D. Solution Specification

It consists of all drawings, materials and parts list manufacturing information and so on necessary for construction of device system or process.

E. Task Specification

The prime responsibility of engineer is to develop more comprehensive, computable information that defines the task

to realize in order to meet the goal. Now, the scope of problem is defined.

F. Manufacture/ Maintenance/ Disribution/ Consumption

The design process must envision and combine provisions for distributions, preservation and optimum substitute of products. Production consideration can have greater effects on design tactics particularly when mass production is foreseen.

III. PROPOSED SYSTEM

In digital modulation, discrete information signal is superimposed over the carrier, which is analog in nature. Digital modulation techniques may be taken as DAC whereas on the receiver side it may be considered as ADC [6-8]. Here we are proposing a system, which provides a simple modulation- demodulation technique using amplitude shift keying. The engineering design process for this system goes as following:

A. Concept

Achieveing ASK using linear modulator was a difficult task. So we desinged our concept to achieve ASK in simplest way possible.

B. Goal

Present case study goal is to achieve ASK using IC MC4051B, which helps digital data to be converted into analog form to pass through BPF channel by using finite number of amplitude samples.

C. Analysis

In ASK system two logic levels (1 and 0) of the data are represented by two carrier signals with different amplitude but constant phase and frequency signal. The mathematical representation of ASK is

$$V_{Ask}(t) = A \cos \omega_0 t \text{ (when logic data = 1)}$$

$$V_{Ask}(t) = B \cos \omega_0 t \text{ (when logic data = 0)}$$

Modulating signal: Square wave (10 V_{p-p} , 200 Hz)

Carrier signal: Sine wave (2.5V_{p-p} , 1KHz)

In the given circuit, Square wave (modulating signal) is given as control input (pin no 11) to the MC4051B (analog multiplexer). Sine wave (carrier signal $A \cos \omega_0 t$) is given at input line X_0 (pin no 13) and amplitude shifted carrier signal $B \cos \omega_0 t$ (using potentiometer) is given at line X_1 (pin no 14). Due to the multiplexing action ASK is generated at the output of MC4051B.

IV. SOLUTION SPECIFICATION

MC4051B is a Motorola, low power, CMOS Analog Multiplexers and demultiplexers IC. It is an analog switch which is controlled by digital pulses, which can be configured as 8:1 multiplexer or 1:8 demultiplexers. It has low ON impedance and very low OFF leakage current.

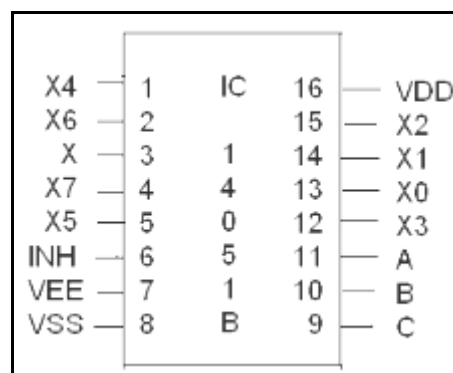


Figure 2: Pin diagram of IC 4051B

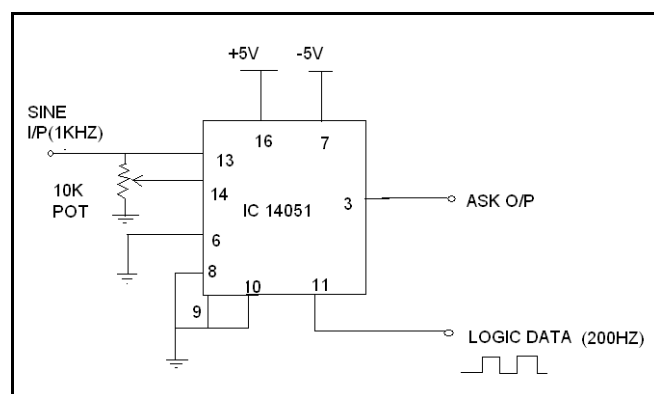


Figure 3: ASK modulator circuit

Peak diode detector is used as ASK demodulator with R-C LPF, is as shown in figure 4 with corresponding waveforms in figure 5.

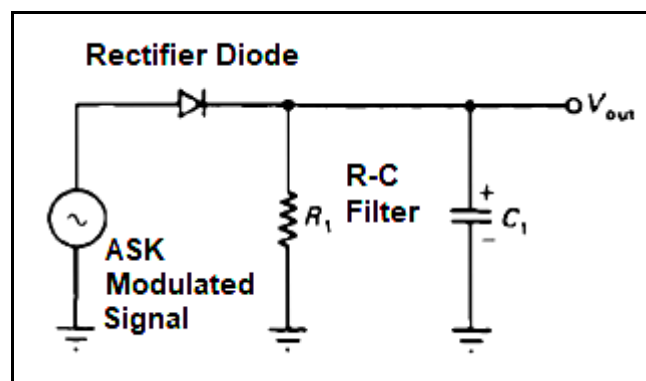


Figure 4: ASK demodulator circuit.

V. RECYCLING OF DESIGN PROCESS

The broad outlines have been shown in figure 5; the details depend on the type of the system to be designed. Recycling of design process is to; Identify, Generate (: Idea, plan, layout, sketch), Refine (:Physical shape, weight, etc.), Analyze (:Engineering science, mathematics and logic), Decide(:Accept, reject, stop, rest) and Implement(:solutions specification model). The steps are repeated until desired specifications have been satisfied. Design engineer should be able to work with multidisciplinary team.

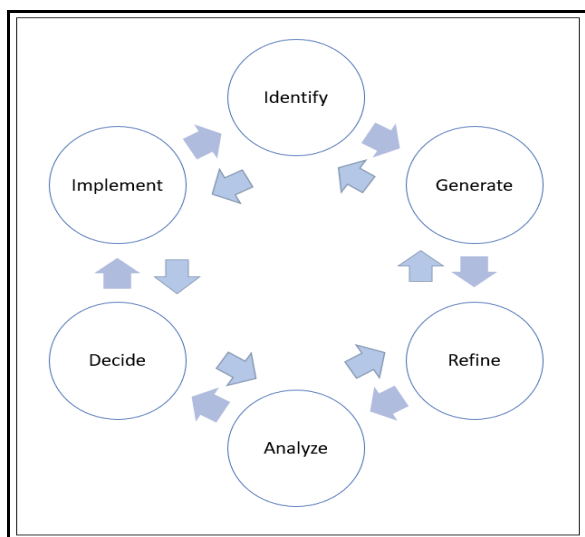


Figure 5: Recycling of design process

VI. RESULT

As shown in figure 3, the modulator circuit which is linear multiplier, generates the ASK waveform. This device multiplies two signals, which are available at the two signal inputs as shown in figure 3. This circuit behaves as product modulator. The sinusoidal signal is selected as carrier since other signals creates the unwanted harmonics, hence increasing the bandwidth. The message is in the form of digital pulses, which is known as modulating signal.

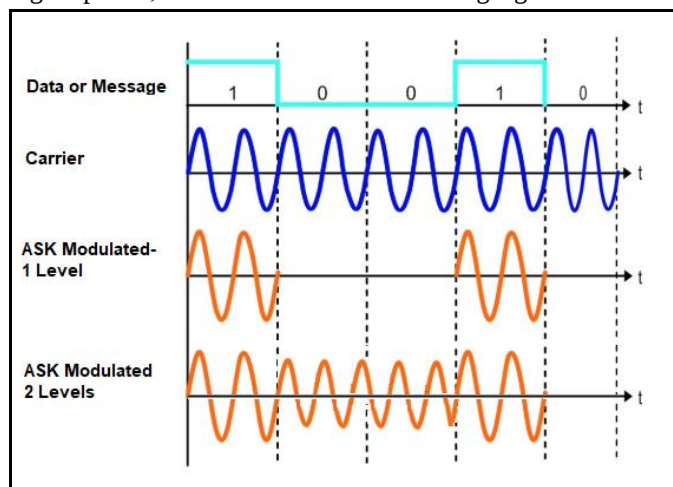


Figure 6: ASK modulation waveforms.

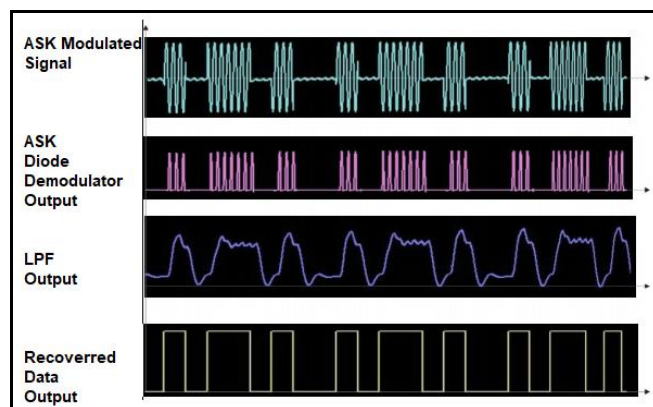


Figure 7: ASK demodulation waveform.

VII. CONCLUSION

In the field of Electronic Systems Design, one can apply the idea to many industries such as medicine, space technology, oil exploration, underwater technology, acoustics and microchip development. Future lies with High Density Electronics System Design and Electronic Embedded systems. Electronic System Design Automation helps in optimizing the system performance, especially timing optimization. This is made possible by proper synthesis of hardware and software.

REFERENCES

- [1] Fundamentals of Electronic Systems Design Authors: **Lienig**, Jens, **Bruemmer**, Hans, 2017, Springer International Publishing
- [2] Electronic circuit design, From concept to implementation, Nihal Kularatna, CRC Press, Taylor & Francis Group, 2008
- [3] Electronic System Level Design, An Open-Source Approach, Editors: **Rigo**, Sandro, **Azevedo**, Rodolfo, **Santos**, Luiz (Eds.), Springer International Publishing, 2011.
- [4] <http://www.me.unlv.edu/Undergraduate/coursenotes/me497/ABETdefinition.htm> downloaded on 02.07.2019
- [5] Seyyed Khandani, ENGINEERING DESIGN PROCESS - Education Transfer Plan, pdf, <http://www.iisme.org/ETPExemplary.cfm>, downloaded on 02.07.2019,
- [6] Kennedy and Davis, "Electronics Communication System", Tata McGraw Hill, Fourth edition.
- [7] WayneTomasi, "Electronics Communication Systems", Pearson education, Fifth edition.
- [8] B.P. Lathi, Zhi Ding, "Modern Digital and Analog Communication system", Oxford University Press, Fourth edition