



International Journal of Engineering Research and Science & Technology

ISSN : 2319-5991
Vol. 5, No. 2
May 2016



www.ijerst.com

Email: editorijerst@gmail.com or editor@ijerst.com

Research Paper

CONSTRUCTION OF INTEGRATED CIRCUITS USING WASTE RECYCLED MATERIALS FROM GUSAU METROPOLIS, NIGERIA

Odimegwu Ann Amarachukwu^{1,2*}, Ezimoha Stella² and Bichi Sanni Mohammed²

*Corresponding Author: **Odimegwu Ann Amarachukwu** ✉ annodimegwu@yahoo.com

Cheaply available discarded electrical and electronic components sourced from Gusau metropolis in Nigeria were employed in developing a functionally usable decoded decimal timer based on the 555-Timer integrated circuit. The circuits systems were constructed by soldering of the necessary components on a traditional vero board also recovered from waste dump. The components were correctly placed firmly in their position on a Vero board followed by soldering. Thereafter, the soldering bit was abraded using file that was to remove excess soldering lead strips on the soldering bit. The integrated circuits after necessary tests proved functional and utilizable. The results of this study prove that cheaply available and seemingly non-useful materials may be recycled to provide useful raw materials for generation of specific integrated circuit to serve desired electronic uses.

Keywords: Integrated circuit, Decimal counter, 555-Timer, Discarded electronics, Easy, Cheap

INTRODUCTION

Digital electronics devices have become an everyday occurrence in our normal routine. Ranging from small electronic devices such as remote controls to more bogus and larger types, digital counters find palpable indispensability (Gerrish *et al.*, 2008). Construction of these electronics component could be costly, an obvious limitation to technological development especially in the developing countries. It may therefore be instructive to consider the possible recycling of discarded electronic and electrical parts for a possible use in the reconstruction of

new electronic components (Jirang and Lifeng, 2008; Engineering Education Research, 2015). Recycling of discarded electronics components could apart from stimulating technological practices in our formal and informal technological training points cum production sites, could also become an economic saver towards a national prudential economic development (Illiceto *et al.*, 2004; Wang *et al.*, 2012; Akinseye, 2013).

Integrated circuits are electronic circuits systems designed to confer and transmit controllable electronic connections between electrically related portions of a device (Vion *et*

¹ Department of Industrial Technical Education, University of Nigeria Nsukka, Nsukka, Enugu State, Nigeria.

² Department of Electrical Electronic Technology, School of Technical Education, Gusau, Zamfara State, Nigeria.

al., 2002; Hart, 2008). They are sometimes called a chip or microchip and may function in various capacities as an oscillator, computer memory, microprocessor, counter, and several other electronic utilities. An integrated circuit provides the framework within which much numerous tiny resistors, transistors, and capacitors are constructed (Electronic Circuits, 2011; Integrated Circuits, 2012). The functionality, control and overall utility of a usable electronic device are made possible through the establishment of a generalized plausible and energy feasible integrated circuits (Hart, 2008).

In line with digitalization, the use of 555 Timer in integrated Decimal counter circuits has continued in spite of certain advances in the overall design. Decimal counters incorporating the 555-Timer would represent a prototypical timer which considering its easy availability could come handy when assembling integrated circuits from purported rubbish or discarded electronics parts in our local environments (Zungeru *et al.*, 2012; Jirang and Lifeng, 2008; Akinseye, 2013).

The outcome of research embodied in this report is aimed at fabrication of a decoded decimal counter incorporating a 555-Timer using cheap discarded materials sourced from the local Gusau metropolis for evaluation as controlling mechanism in any sample timer requiring machinery.

MATERIALS AND METHODS

Collection of Discarded electronic materials

Discarded electronics materials which included transistors, capacitors, oscillators, and other items were collected from roadsides electrical repairs shops, and along the road, from discarded items dump sites. In some cases these items

were taken free since they are discarded, or purchased at negligible cost as non-useful “throw away” materials.

Construction of the Components

The circuits systems were constructed by soldering of the necessary components. Components were correctly placed firmly in their position on a Vero board. Soldering lead made up of either 40% lead and 60% tin at about 183°C melting point was utilized. The soldering lead was then placed on the copper wire and the soldering bit applied onto it. Care was taken to ensure the heating ensued at the required temperature until the bit melts the solder and joint established between the component and copper strip. Thereafter, the soldering bit was abraded using file that was to remove the soldering lead strips on the soldering bit (Electronic circuits, 2011; Gerrish *et al.*, 2008).

TESTING OF THE ELECTRICAL CIRCUIT COMPONENT

The electrical circuit components were initially tested using ohmmeter at the earlier stage to confirm the functionality of the individual components before proceeding to develop the circuit. Thereafter, the generated circuits were further tested with considerable focus on the soldered joints which were tested using an ohmmeter with suitable range (Gerrish *et al.*, 2008).

At every stage of the construction, the components were tested to ascertain their functionality, adequate synchronization with available power supply source, and intended use.

RESULTS

Using the electronic components sourced from discarded electronic items the whole procedure

was connected on a 16-pin 0.1 Vero board which allowed the chance of changes needed during the construction. Functional chips and semiconductors were sorted out and extricated out of the collected electronic items while leaving out the damaged ones. Using the functional components the integrated circuit 4017B was set up with the positive terminals of the light emitting diodes (1-5) on the right sides of the circuit connected to pins 3-7 of the integrated circuit (Figure 1). This set up aimed to ensure optimal functionality for necessary and effective transmission. Additionally, pin 3 of the circuit (4017) was also connected to the base of

transistor BC 109 through the necessary 100n resistor (R1) (Figures 1 and 2). Correspondingly, the emitter of the transistor BC 109 was connected to the ground through resistor R3 (100kn). And, in order to adequately resolve this, the collector terminal of the transistor was connected to pin 16 of Integrated circuit 4017 through resistor R2 (100n. pins 8, 13, and 15) connected to the ground (Figures 1 and 2).

Meanwhile, on the left side of the Integrated circuit 4017, the positive terminal of the light emitting diodes 6-8 were connected to pins 9-11. Whereas, pins 2 and 14 of the Integrated circuit were connected to pin 2 through diodes IN 4001

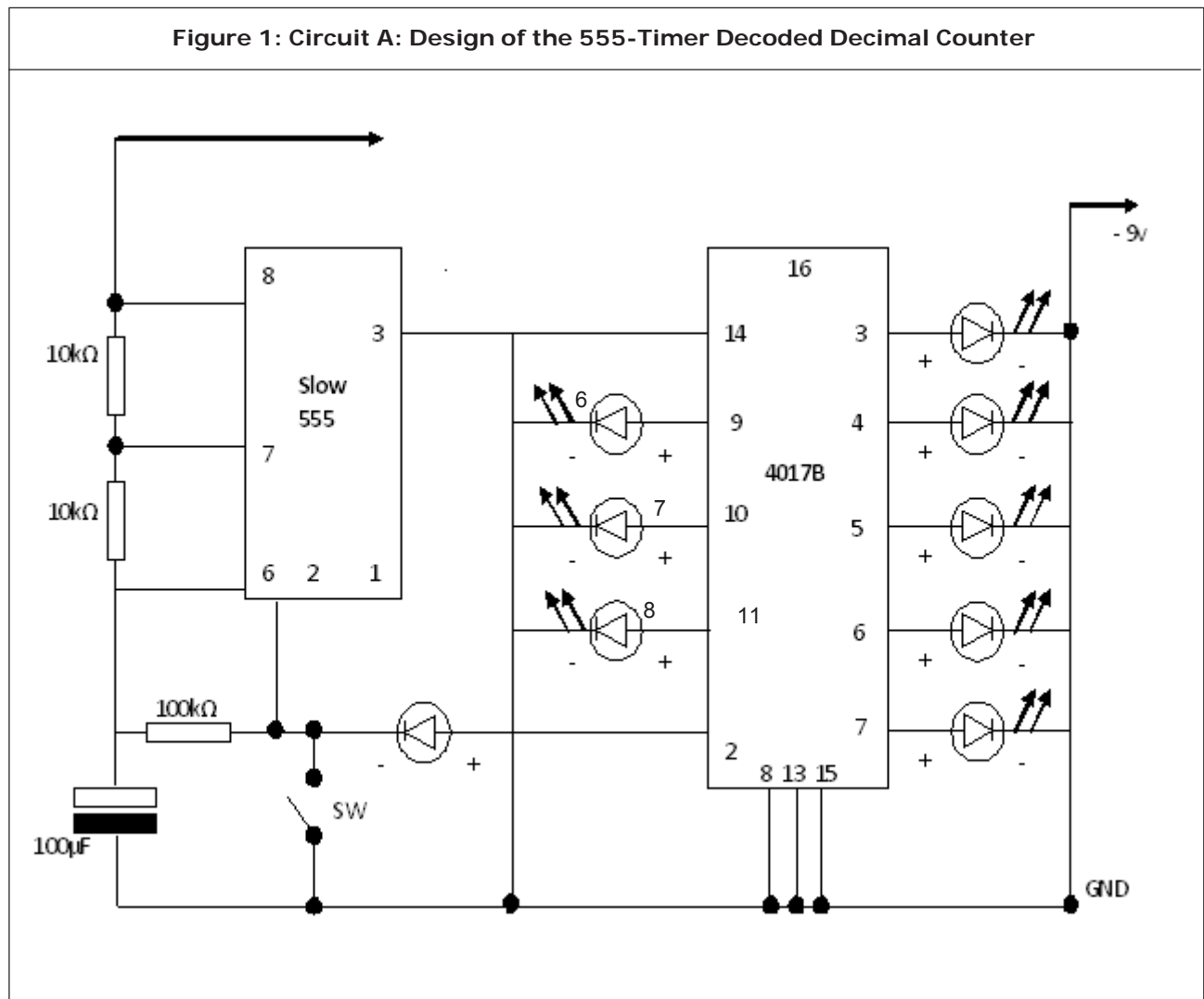
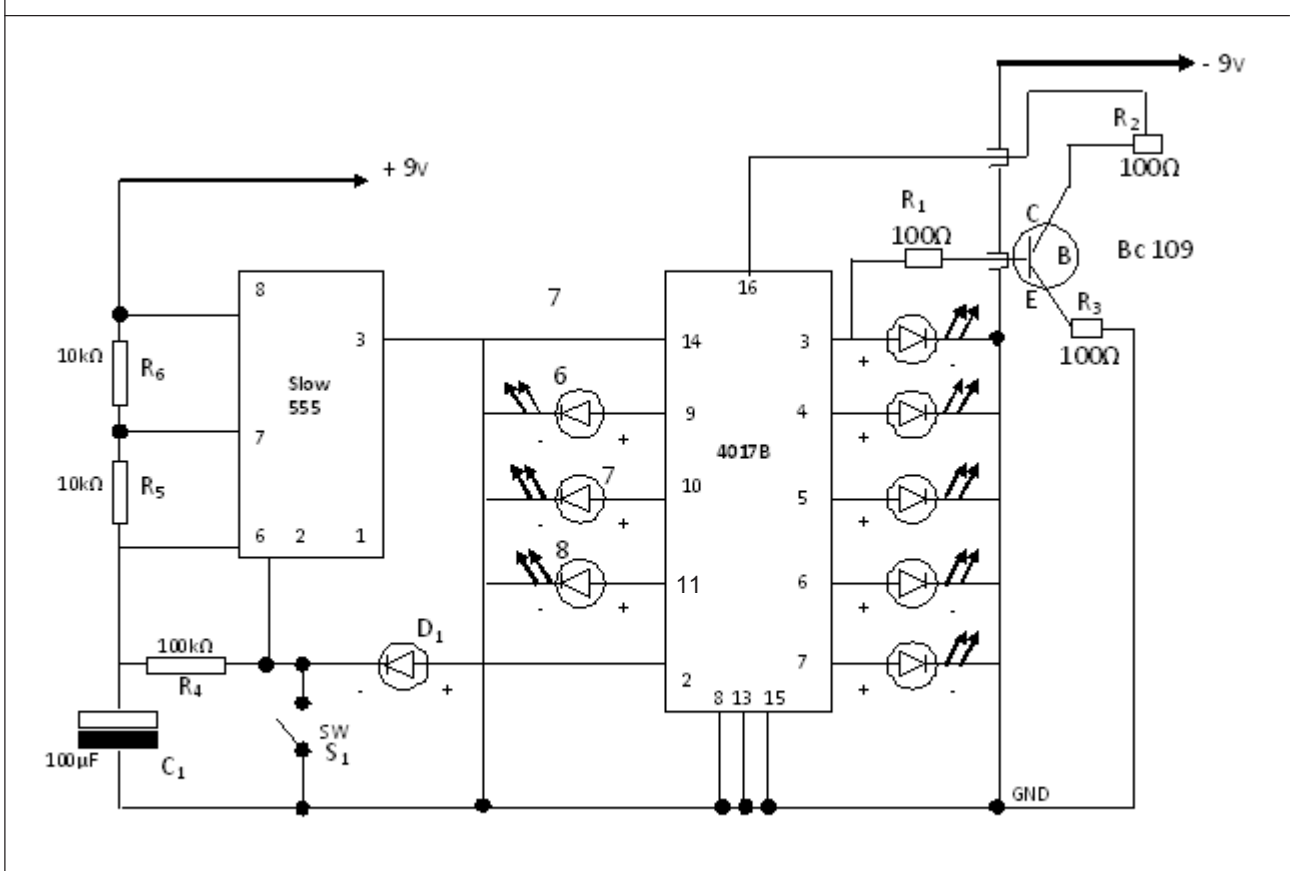


Figure 2: Circuit B : Decimal Counter with Added Bc 109 Transistor



(D₁) and pin 3 of the 555 Integrated circuit to the ground respectively (Figures 1 and 2).

However, on the left side of the 555 timer integrated circuit, resistors R5 and R6 were connected to pins 6 and 7 to the positive end of the supply. A 100kn resistor R4 connects pins 6 and 2 with capacitor C₁ of 100µF to the ground across a switch Sw (Figures 1 and 2).

DISCUSSION

Integrated circuits with counter functionality have been constructed using discarded and freely available components materials. The whole process highlights the cheapness of this approach of sourcing materials for circuit developments (Zungeru *et al.*, 2012).

The Integrated circuits employed in our study promotes different output which are found useful in certain household machinery as a controlling mechanism for the machine. The age of digitalization is fueled on amongst others due to the reliability of the On-Off types of operations in contrast to analogue systems. Therefore, this study chose to construct circuit A after comparing the feasibility of the digital circuit (circuit A) to the analogue circuit (Figure not shown) functionalities in relation to the expected use. Ordinarily, the analogue circuit (Not shown) would employ light-emitting diodes which display pulses at the same time. This would imply that they synchronize at the same time without a time intervals to each other. This contrasts with the digital circuit A (Figure 1) the platform on which our constructed

Integrated circuit was based on serving the expected purpose. The presence of the 555-Timer in the Integrated circuit A completed the goal of ensuring a timing system for sustainable digital outcomes necessary for the efficient functioning of our cheap locally fabricated circuit. Following the construction and testing of circuit A, the transistor BC 109 was additionally incorporated alongside some extra resistors as a means towards the optimization of the electrical pulses recoverable from the entire set-up thereby giving rise to circuit B (Figure 2).

The outcome of this research has demonstrated that useless and discard electronic materials which otherwise would have proven environmental health hazard could be channeled to useful application simply by collation of such materials to deliberate and gainful utilization for the design of electronic circuits (Jirang and Lifeng, 2008). Additionally, not only are these would-be discarded electronic materials cheaply available, their re-use could also probably save time given that less time may be spent on the fabrication of the needed electronic circuit for the standby consumer in the locality when compared to the material and time costly nature of industrial made components (Zungeru *et al.*, 2012; Jirang and Lifeng, 2008).

CONCLUSION

A decoded decimal timer based on the 555-Timer integrated circuit has been developed using cheap available component materials sourced from Gusau metropolis. The integrated circuit after necessary test established overall utility. Therefore, cheap available seemingly non-useful materials may be recycled to provide useful raw materials for generation of specific integrated circuit to serve desired purposes.

ACKNOWLEDGEMENT

The authors wish to acknowledge the technical staff of the Department of Electrical Electronic Technology, School of Technical Education, Gusau, Zamfara State, Nigeria.

REFERENCES

1. Akinseye V O (2013), "Electronic Waste Components in Developing Countries", *Annual review and Research in Biology*, Vol. 3, No. 3, pp. 131-147.
2. Electronic Circuits (2011), Projects, Electronics Design, Circuit Diagrams, Electronics Hobby Kits and Schematics, online available at: <http://www.electronic-circuits-diagram>.
3. Engineering Education Research: Part 1 Electrical Circuits (http://www.didaktik.itn.liu.se/thesis/margarita_thesis2.pdf). Assessed 12.01.2016.
4. Gerrish H H, Roberts R M and Dugger WE (2008), "Electricity and Electronics study Guide with Laboratory Activities", *Goodheart-Willcox Publisher*.
5. Hart C (2008), "Models in Physics, Models for Physics Learning, and Why the Distinction may Matter in the Case of Electric Circuits", *Research in Science Education*, Vol. 38, pp. 529-544.
6. Illiceto F, Gatta F M, Masato P and Sysoulath H (2004), "Rural Electrification in developing countries with the shield wire scheme application in Laos", *International Council on large Electrical Systems (CIGRE)*, (<http://www.transform.ru/articles/pdf/sigre/c6-301.pdf>). Assessed 12.01.2016.

7. Integrated Circuits (Chips), (Accessed 2012), online available at: www.kpe.freeuk.com/components/ie.htm.
8. Jirang C and Lifeng Z (2008), "Metallurgical Recovery of Metals from Electronic Waste: A Review", *Journal of Hazardous Materials*, Vol. 158, pp. 228-256.
9. Vion D, Aassime A, Cottet A, Jovez P, Pothier H, Urbina C, Esteye D and Devoret M H (2002), "Manipulating the Quantum State of an Electrical Circuit", *Science*, Vol. 296, No. 5569, pp. 886-889.
10. Wang F, Huisman J, Meskers C, Schluep M, Stevels A and Hagelucken C (2012), "The Best-of-2 Worlds Philosophy: Developing Local Dismantling And Global Infrastructure Network For Sustainable E-waste Treatment In Emerging Economies", *Waste Management*, Vol. 32, pp. 2134- 2146.
11. Zungeru A M, Maidawa K D, Ambafi J G and Omokhafa J T (2012), "Design and Implementation of a Low Cost Digital Bus Passenger Counter", *Innovative Systems Design and Engineering*, Vol. 3, No. 4, pp. 29-41.



International Journal of Engineering Research and Science & Technology

Hyderabad, INDIA. Ph: +91-09441351700, 09059645577

E-mail: editorijerst@gmail.com or editor@ijerst.com

Website: www.ijerst.com

