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Design and Implementation of Paper Vending Machine for Retail of Common Usable Papers for Unstop Students

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Abstract: Automation's biggest advantage is very beneficial in all contexts. It brings efficiency, ease management and possibility of multitasking. This prototype provides a solution posted among paper retailers in printing/photocopy shop centers in University of Science and Technology of Southern Philippines for students using bond papers, newsprints and yellow papers as answer sheets in their exams and for some other purposes. Retailing such papers are very manual, it is tediously counted piece by piece by the shop attendant. With limited human resources, these retail centers somehow managed multitasking in a hard way. Henceforth the possibilities of accuracy on giving the number of papers that commensurate the amount is compromised and also not discounting the dishonesty among some of the buyers. This paper vending machine utilizes a coin-slot machine and will automatically dispense paper of choice by the student depending on the amount inserted.
Keyword - automation, coin-slot, multitasking, accuracy, dispense

I. INTRODUCTION

Today's modern business is all about process automation. This automation is simply integrating softwares and machines;from simple to complex automation, it is a strategy geared toward better profits, effortlessness in management and varied multitasking. Vending machines are one example of an automation business process in which it utilizes meager supervision of the user. There are a lot of variety and forms of automation using vending machines.

The photocopy/printing shop here in the University of Science and Technology of Southern Philippines offers diverse services to its clientele. Primarily it offers document photocopying and printing services. But somehow, with the owner's business innovativeness, it also offers sale of commodities such as candies, sliced fruits, papers (bond papers, newsprint and yellow paper) and so much more. With a minimum of one to two people manning the shop, it caters a whole lot of students in the campus.

Among the commodities offered that is considered very stressful and painstaking in serving its plentiful clientele is the retail of common papers; short/long/A4 bond papers, newsprints and yellow papers. These papers are usually used as answer sheet/s by the students in the exams. The cost per piece of paper is Php 1.00.

This project aims to develop and implement automated piece-by-piece retail of common papers. This vending machine will dispense short/long/A4 bond papers, newsprints and yellow papers. This machine utilizes coin-slot to accommodate Php 1.00, Php 5.00 and P10.00 coins. The buyer will simply select the type of paper and insert coin/s. This machine will not dispense change in amount.

A. Conceptual Framework

Figure 1.1 shows the block diagram of the research concept. The project begins with short analysis of the retail of common commodities sold among the different printing/photocopying shops with respect to the clientele served as against to the personnel manning the store. It also considers the way these commodities are sold and how tiring if many customers are cueing to buy these papers.

PROCESS talks about the conceptualization then the integration of the important electronics parts/circuit of the machine. The Input would greatly affect how the papers would be dispensed out of the vending machine. An initial user feedback is required to further improve the prototype. Then lastly, the OUTPUT serves as the validation, if truly the machine could address the tedious serving of the paper retailing.

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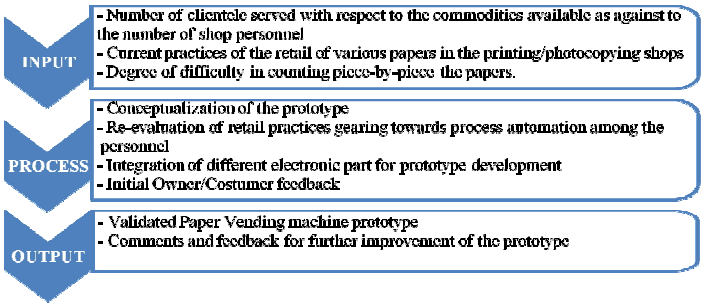


Fig.1. Conceptual Framework of the study

II. DIZCUSSION

A. Shop services assessment

There are four photocopy/printing shops in the university serving student population varying from 9,000 to 10,000 students in the past years, not considering the university personnel. These shops are located separately to cater specific group for students. Table 1 shows the variety of servicesoffered in all of these shops. It is also noted that these shop are in placed for the immediate common papers supplies and needs of the students and also with the university personnel.

TABLE I
FONT SIZES FOR PAPERS

	Shop location			
Items	LRC bldg	ICT bldg	Bldg 5	Scicombldg
Photocopying services	□	□	□	□
Printing services	□			□
Papers (short/long, newsprint and yellow paper)	□	□	□	□
Assorted delicacies (candies, lollipops, etc)	□	□	□	□

These small shop setup by private owners through rental of placein the university premises and is run by the family members of the owner. In many cases, unfortunately, there is one personnel manning the shop, this find very difficult to serve its customers in a daily basis. Table 2 shows which services viewed by the owners as difficult to render. The difficulty depends on the volume of items and the pieces desired by the buyer. It's simply rating from 1 to 5 scale. 1, being for VERY LESS DIFFICULT, a rate of 2 for LESS DIFFICULT, a rate of 3 DIFFICULT, a rate of 4 for MORE DIFFICULT and 5, for VERY DIFFICULT.

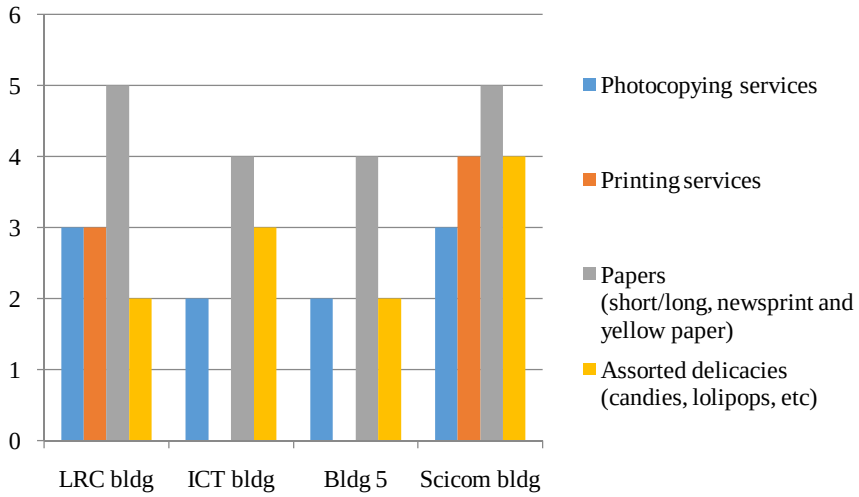


Fig. 2. Degree of difficulty of each service/s per 10 clients served

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Figure 2 also reveals that the retail of papers (bond papers, newsprint and yellow papers) are the most stressful to render. The difficulty is apparently due to the counting piece-by-piece the papers. Call it multitasking, but somehow some other customer transfer to another shop just to purchase one or two papers for that matter. The owner has to have focus on counting the papers to be accurate. In turn the customers tend to cue, waiting for be served with the same item or some other items.

B. The Customer's view

Among the services offered by the different photocopy/printing shops in the university, the most rendered service is the photocopying. Students come to these shops to have their documents photocopy. The second most availed service is the purchase of common papers, Figure 3. These papers are short and long bond papers, newsprint and yellow papers. These papers are used extensively as answer sheets for exams/quizzes and documentation for the project.

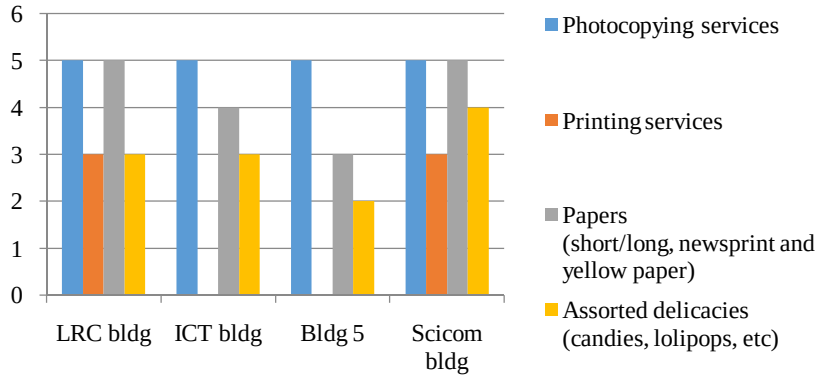


Fig. 3.Level of most sought service/s per 10 clients served

III.METHODOLOGY

A. The Prototype design

Vending or simply automatic retailing is a process of selling merchandise via automated machine. It is always built with a coin-slot device that accepts coins as exchange amount of the item desired (Bellis, 2017). This project aims only to automate the process of retailing of common papers used by the students. This prototype would dispense the number of papers that the customer desires with respect to the coin/s inserted. Figure 4 shows the concept design of the machine (not drawn to scale).

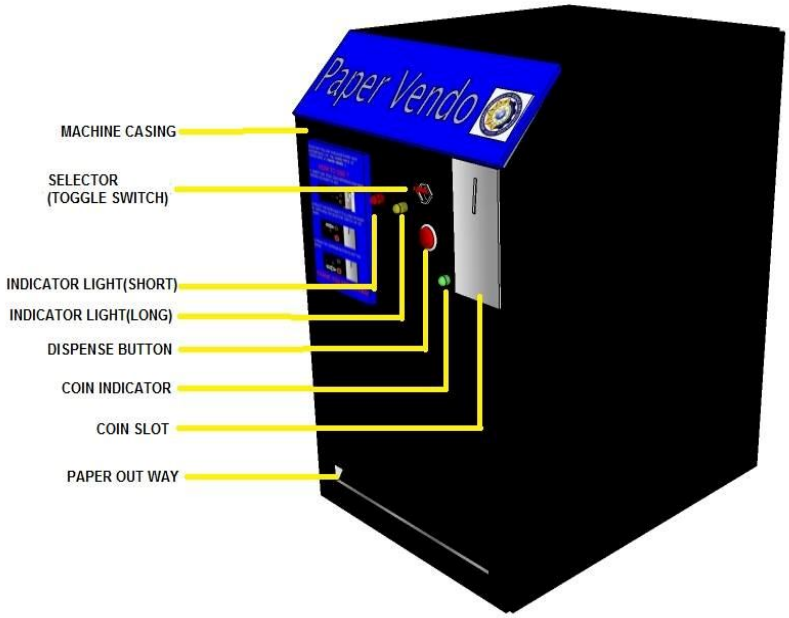


Fig. 4. Design concept of the prototype

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The machine shall be operated through selector switches and with the coin-slot device. Indicators are also evident to monitor the status of the machine while operating it. The prototype is using out-dated printer parts. Components of which that can be re-used and recycled. Papers/s will be dispensed through the paper out way located at the lower space of the machine.

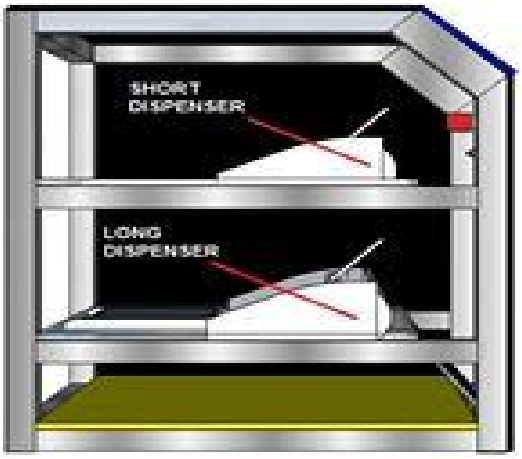


Fig. 5. Inset design concept of the prototype

B. The Electronic circuit

The heart of the circuit utilizes the PIC16F84A microcontroller device (Figure 6). The output of the device was interfaced with a motor driver shield to control the rotation of the dc motor. The design of the project also used selector button, dispensing button, and an indicator lights.

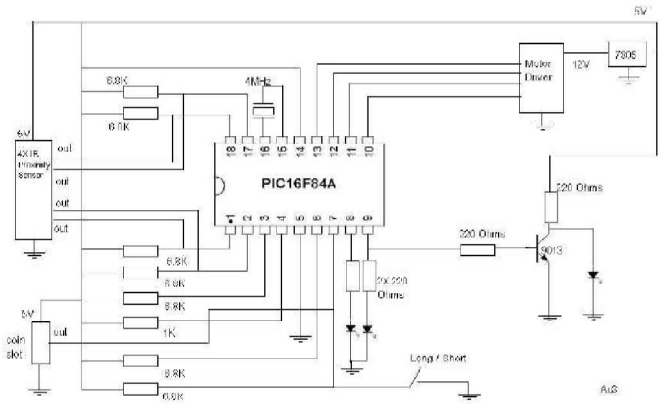


Fig. 6. The main electronic circuitry

PIC16F84A microcontroller device is an 18-pin Enhanced FLASH/EEPROM 8-Bit Microcontroller. A high performance RISC CPU with operating speed of DC - 20 MHz clock input and DC - 200 ns instruction cycle. It has the capability of 13 I/O pins with individual direction control and a high current sink/source for direct LED drive, also with a selectable oscillator options (2001, Microchip Technology Inc.)

The IR proximity sensors are used to detect whether there are still available papers stored in the machine. The coin slot can accommodate P1.00, P5.00 and P10.00 coin (Philippine peso coin). The paper dispensing section is driven by a servo motor interfaced with the motor driver circuit.

C programming language is used because of its simple architecture and the essence of availability and accessibility of programming hardware. The machine code was written into the PIC16F84A microcontroller automatically. Once the machine code of the program had already been embedded into the microcontroller, an interface circuit was designed to drive an external load. The design

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considered the maximum specifications of the device as to its current driving capacity. The project circuit was designed according to the operation based on the simulation of the program.

C. Evaluation

The machine was evaluated using descriptive statistics utilizing the five-point rating scale that measures the acceptability of the paper vending machine in accordance to the following criteria:

As to functionality – technical evaluation of the machine in terms of its accurateness of dispensing, maintenance and power;

As to cost effectiveness – evaluation of the prototype as a stand-alone machine while rendering other services;

As to mobility – evaluation of the prototype considering its space occupancy and weight; and

As to its over-all impression – in terms of aestheticsand marketability.

IV. RESULTS AND RECOMMENDATIONS

A. The prototype

The machine stands 20" tall, 13" wide and 18" in length (Figure 7). The designed dimensions are sufficient in accommodating improvised printer dispensing section that is modified to be the storage and dispensing mechanism to pull the desired number of paper/s (Figure 8).

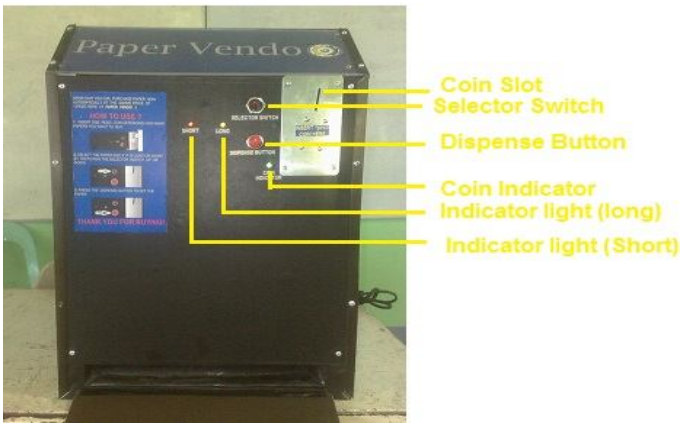


Fig. 7. The output prototype

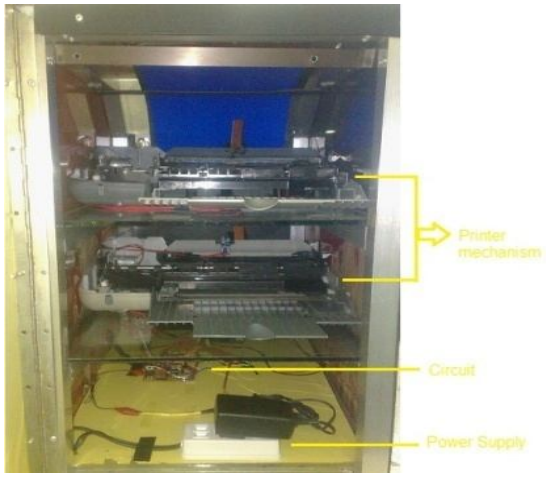


Fig. 8. The paper storage and dispensing mechanism

B. Evaluation results

The evaluation was first conducted to the owners of the shops and then to the clientele. The evaluation was in a form of questionnaires with specific points to assess the total functionality of the machine. The rating is from a 1 to 5 scale. Scale 5 to be the highest rate.

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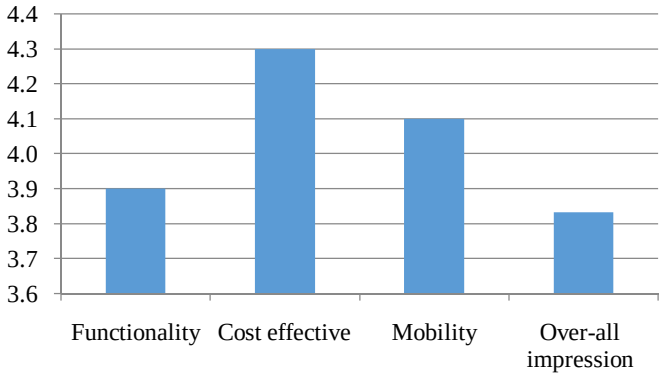


Fig.9. Mean responses of the predetermined assessment parameters

Figure 9 shows the result of the assessment. Both the over-all impression and functionality parameters are quite a bit low, this is due to the usage of some recycled printer part integrated to the machine and so accuracy was an issue in this prototype then. The usefulness and mobility clearly point out the demand for the prototype to be incorporated in the conduct of business among these shops.

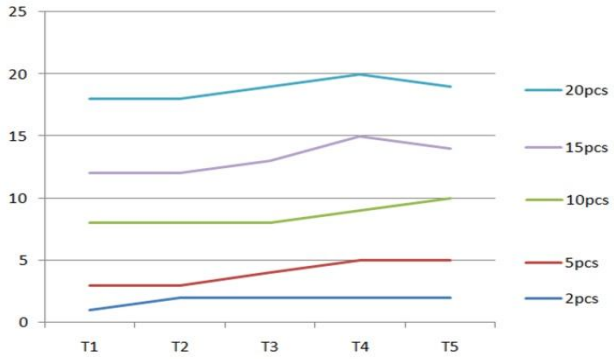


Fig. 10. Test of paper dispensing accuracy

Figure 10 shows the test of accuracy of number paper dispensed. The trial involves a preselected number of pieces; 2, 5, 10, 15 and 20 with respect to its actual dispensed number of papers. In a series of five trials conducted the machine dispenses the number of papers of whom the user desires. There a very small margin of error in the dispensing of 15 and 20 pieces respectively.

C. Recommendations

The recommendations of this prototype focus on the negative impression from users, both shop owners and clienteles. The following are mentioned to help improve the prototype:

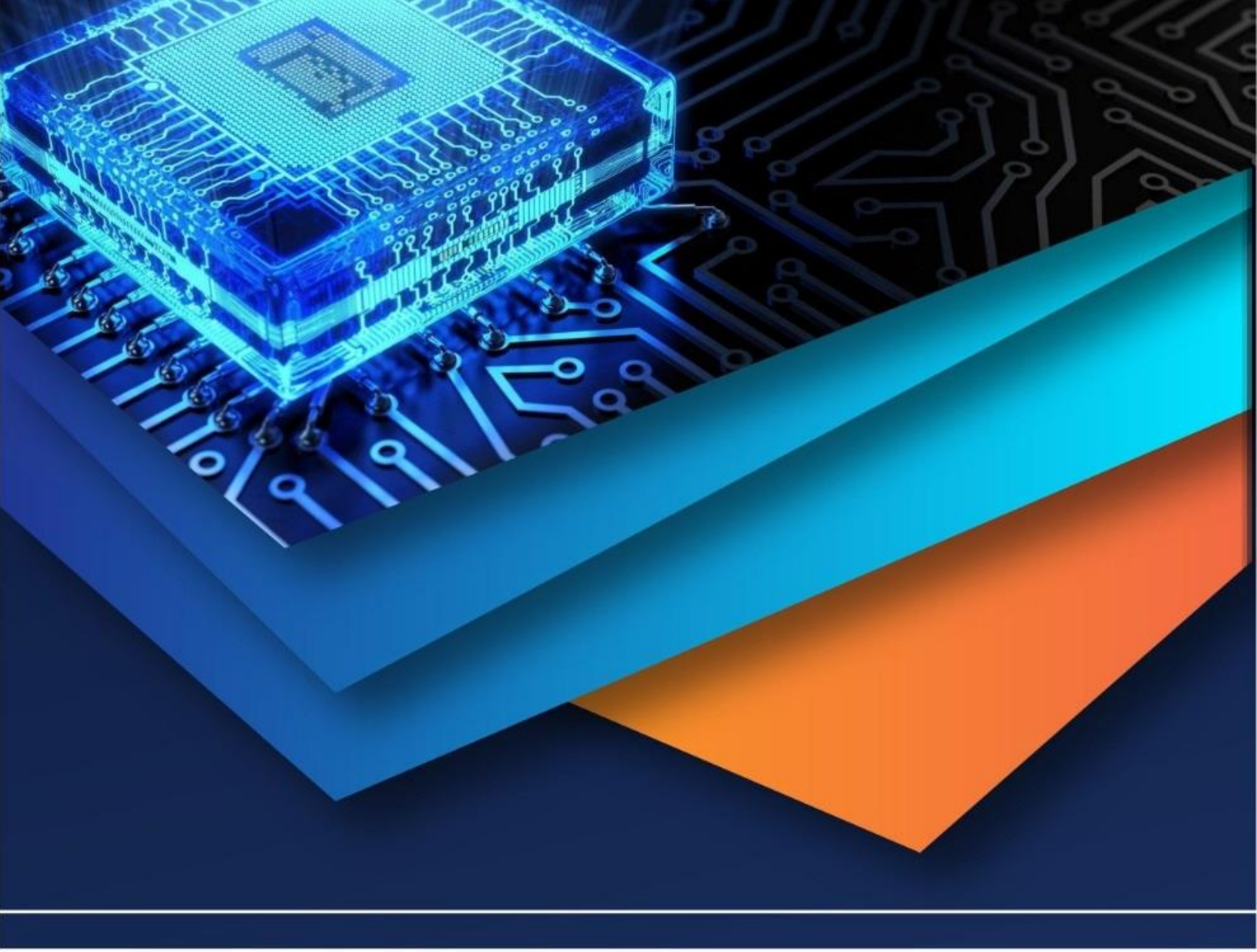
1) To assure correctness of the number of dispensed paper, it is recommended that not to use recycled printer parts. Use instead industry-grade motors, rubber feeders and paper storage. With this also aesthetics can also be improved.

2) A standby battery is suggested to render uninterruptible vending service.

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