INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 7, Issue 3 - V7I3-1991)
Available online at: https://www.ijariit.com

Smart medical package

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ABSTRACT

The prime objective of this project is to create a smart package for medicines using the printed electronics technique which enables LED light to glow. Insulin's that are used in houses might not be stored under proper storing temperature. So a temperature sensing circuit is printed in the insulin package with a LED light glowing for indicating the improper storing temperature. When the user handles this package, it provides information about the storage temperature of the medicine. Screen printing technology is employed for circuit printing and digital printing for package printing. Silver conductive ink is used for circuit printing and components pasting. SMD (Surface Mount Device) components are used in the circuit. A smart package is developed to deliver the information exactly, thus making packages smarter will enable the users to grab the information easily and can be used in an effective way..

Keywords: *Package Printing, Circuit Printing, Smart Package, Printed Electronics*

1. INTRODUCTION

New developments in packaging technology, particularly the integration of digital information on the packaging substrate, appear to be an emerging issue for packaging printing. Recent advancements in fields such as electronics, information technology (IT), materials, and processes have resulted in new applications in packaging that are described as "intelligent," or "smart,".

In recent years, there has been a lot of interest in a fully printed sensor or system on a flexible polymer substrate. PET (polyethylene terephthalate) film is one of the most commonly used polymeric substrates.

In this paper, PCF (Poly Carbonate Film) sheet is used as the base substrate here. For high volume and low-cost manufacturing, screen printing is used as an additive patterning process to print conductive patterns on PCF films. Silver conductive ink is used for printing the conductive patterns in the film. SMD (Surface Mount Device) components are used in the printed circuit. For packaging multicolor printing is opted.

2. LITERATURE REVIEW

In smart packaging applications, all major printing processes will be used, allowing for the implementation of printed electronics. However, as technology advances, new substrates, inks, and layers may be required, and printing processes may need to be adapted to new production environments [1].

Screen printing and via-hole filling are used to create wireless sensors on flexible plastic films. The wireless sensors are battery-free and can transmit data and power. RFID technology is used to design the sensors, which are fabricated on polyethylene terephthalate films. Screen printing, an additive patterning process, is used to create metallization on polymer films. Metallic patterns are printed on both sides of a polymer film and connected with micro vias filled with conductive paste. The printed electrical traces on one side of the film are for discrete components such as resistors and transistors that would be mounted on it; the printed electrical traces on the other side are for discrete components such as resistors and transistors that would be mounted on it [2].

Silver is one of the most highly used material for conductive inks. Flexible electronics and optoelectronics applications can benefit from conductive ink patterns. Because of its high electrical and thermal properties, silver has been considered a better pigment material for conductive inks. For conductive ink

formulation, a thorough understanding of the synthesis of Ag NPs using various chemical methods is required [3].

Insulin storage is highly managed and monitored throughout the supply chain. Optimal insulin storage after dispensing, when used by PwD, and when kept at home is not and cannot be guaranteed, since it has been proven that domestic refrigerators have a risk of storing insulin at temperatures below freezing point in a number of situations. Recent statements call for the creation of a consensus statement as well as the identification of areas in which more study on insulin thermo stability is needed. More thorough information on insulin stability at different temperatures should be made available by manufacturers. Data from CGM sensors, insulin dose, and temperature sensors will be analyzed to provide further insight into probable patterns of insulin sensitivity changes in real-world situations [4].

3. METHEDOLOGY

A. Workflow

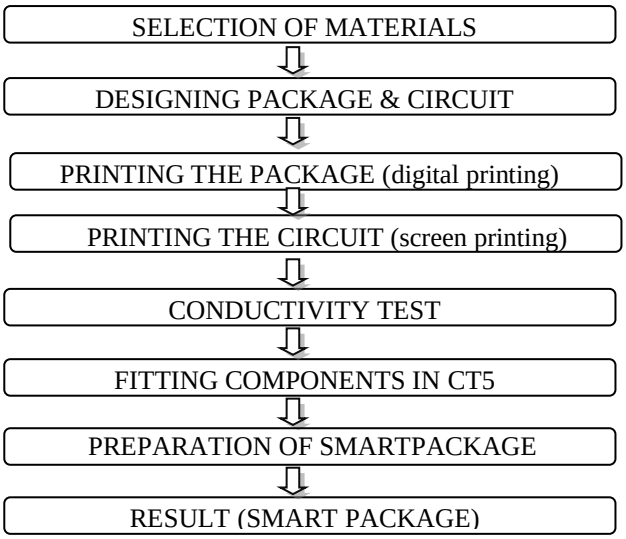

Fig. 1: Workflow

B. Materials Required

Substrate

1. CT5 sheet

Electronics Components

1. Battery - 5 Volts
2. SMD LED - Green & Red
3. SMD Resistor - 2k, 10k & 470Ω
4. SMD 741 op amp.
5. Preset - 2k
6. LM35 Temperature Sensor

Screen Printing Equipments

1. Mesh
2. Squeegee
3. Mounting table

Ink

1. Silver conductive ink

Miscellaneous material

1. Double side adhesive

4. IMPLEMENTATION

A. Structural Design & Graphical Design

Software used: Packmage& CorelDraw
Package size: 13" x 19 " (ref Figure 2)

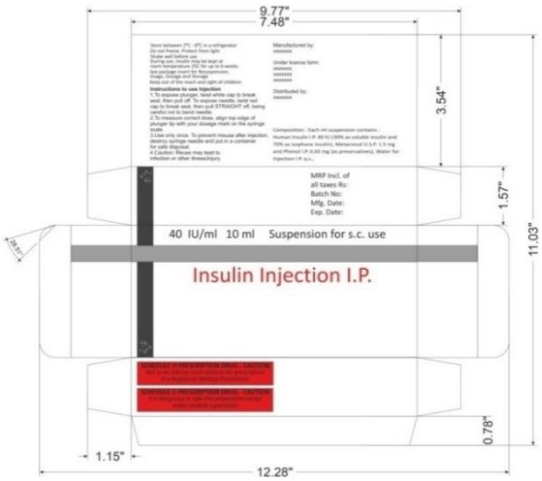

Fig. 2: Graphic Design

B. Designing The Circuit

Software used: Proteus and CorelDraw
Procedure:
Proteus is a virtual system modelling and circuit simulation application. Proteus ISIS Schematic capture is opened. From the left toolbar, choose component mode. Add all of the essential components by clicking on P(pick from libraries). Arrange the parts on the workstation. Wire up the circuit. Click on play button on the bottom left to start simulation Save the file in PDF format and import it in CorelDraw. By using the second layer, draw the dielectric layer. Next, the cutting marks and registration marks are given.Save the file and send the CorelDraw document for positive film making

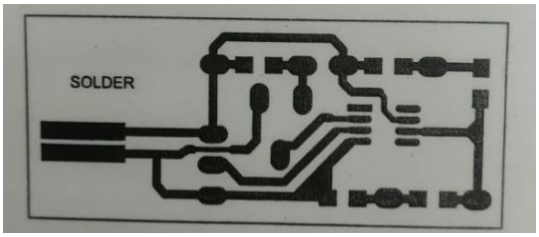

Fig. 3: Film

C. Printing

Circuit printing

Screen printing is a printing technique in which ink is transmitted to a substrate through a mesh, with the exception of areas where a blocking stencil makes the ink impervious to the ink. It's can also be called as serigraph printing or serigraphy

Printing procedure

Heat stabilized polyester film is used for printing on PCF. The film undergoes preheating by IR dryer at 120°C to avoid shrinking. After preheating the film is cleaned with thinner on both sides. There should be 3mm gap between the mesh and the flat desk. Registration is done based on the cutting marks given on the screen. The ink should be mixed gently for about 10 minutes. First take a rough print and check the deposition of ink and registration. Then clean the screen with reducer. The top layer of the circuit is printed by using silver conductive ink and is dried by IR dryer at 125°C(ref Figure 4)

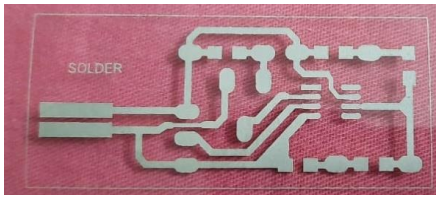

Fig. 4: Printed Circuit

Package printing

Digital printing refers to the process of directly printing a digital picture onto a variety of mediums. Small-run works from desktop publishing and other digital sources produced using large-format and or high-volume laser or inkjet printers in professional printing.

Procedure

The designed file is converted to PDF Convert the given image to CMYK and white form The following settings are done
Resolution: 600x600 VD
Type: Full colour
Print direction: Bi direction
Scan speed: High
Halftone: ILL Diffusion (default)
Rip the file and click on execution command The printing head transfers the ink onto the substrate in the form of dots. The UV-curable ink is cured and adhered to the substrate by UV radiation.

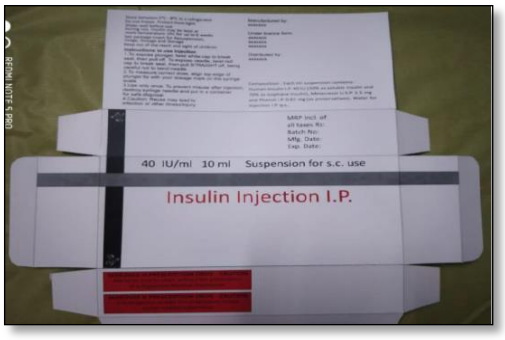

Fig. 5: Printed Package

D. Fixing The Components

The silver conductive ink is used to paste the components on the PCF. Glue is used to lock the components on film. The pasted circuit is allowed to cure for one to two days (ref Figure 5)

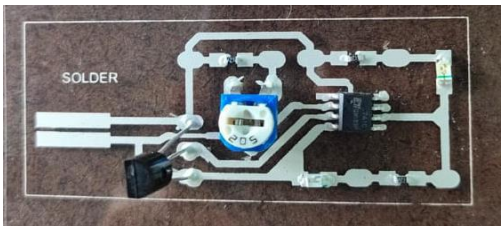

Fig.6: Components fixed

E. Tuning Of Pre-set

There are 3 pins/terminals on a pre-set. Pre-sets can be adjusted from its minimum to maximum value within a single turn. Take a box contains ice cubes for measuring the temperature between 2°C to 8°C. Measure the temperature using the digital measuring devices to check the temperature within the box. When the temperature is at 8°C the pre-set is tuned to cut - off. When the pre-set is turned anti clock wise the temperature rises whereas when it turned clock wise the temperature cut-off at the set limits. The temperature set in pre-set is done by turning the pre-set anti clock wise and once it reaches the required temperature, the pre-set is turned clock wise and made to cut off. The turning is done using either screw driver or such devices.

5. TESTING

After printing and pasting the layers for smart package it undergoes the testing.

Conductivity Test

The resistance between two points in the circuit is tested during conductivity testing. The resistance of an item is mostly determined by the substance it is constructed of; electrical insulators, such as rubber, have extremely high resistance and poor conductivity, whereas electrical conductors, such as metals, have extremely low resistance and great conductivity. To quantify this material dependency, resistance or conductivity are utilised. Multi-meters and ohmmeters are used for continuity tests.

Testing Procedure

1. Take the printed circuits to be tested
2. Take the multi-meter to test the resistivity or conductivity.
3. In the test equipment, choose the right test function, which is the low reading ohm metre function (200k)
4. Remember to null the test instrument if necessary. Connect the two test leads together and push the TEST button until the displayed measured value hits ero ohms.
5. Measure between each line in the circuit. The multi-meter must display the value as 0 or very less resistance like few ohms. If the multi-meter shows 0 ohms, it refers that there is perfect conductivity.
6. Note the readings of the 4 points.(ref Figure 6 & Table 1)

Table 1: Conductivity test

S no.	Connecting points	Multi-meter Reading (inΩ)
1.	Point 1	0.023
2.	Point 2	0.011
3.	Point 3	0.012
4.	Point 4	0.015

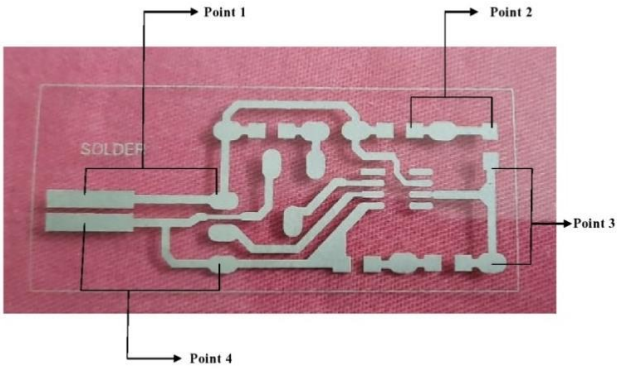

Fig. 7: Tested points in circuit

6. RESULT

When the package is placed above 8°C, the red light glows, indicating to refrigerate the package. The green color indicates that the circuit connections are correct and is in working condition as shown in Figure 7.

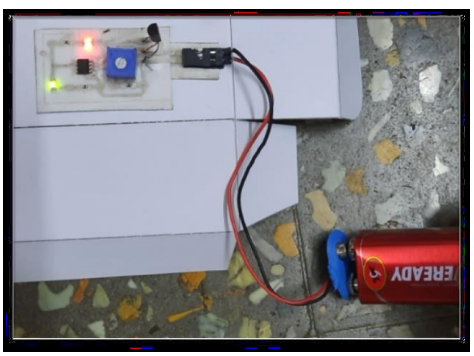

Fig. 8: Package placed above 8°C

Here, by keeping the package in between 2°C and 8°C, the red light stops glowing which indicates the package is safe as shown in Figure 8.

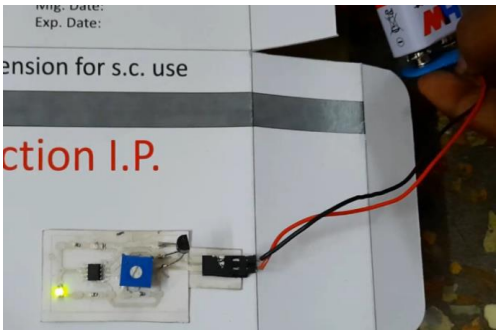

Fig. 9: Package placed between 2°C and 8°C

Thus, a smart medical package for unopened vials of insulin was developed in our project.

7. COST CALCULATION

Table 2: Cost calculation for

S.NO	Particulars	Qty/ No's.	Unit Price (Rs)	Amount (Rs)
1.	**Raw materials**			
	Film	1(A7 size)	3.75	3.75
	Ct5	7(A7 size)	20	140
2.	**Pre - press**			
	Circuit design	1	400/ hr	400
	Package design	1	400/hr	400
3.	**Press**			
	Ink	3ml	110	330
	Printing charges	25	5	125
4.	**Finishing**			
	Components fixing	200	4/ components	800
5.	**Packaging**			
	Printing cost	25	25	675
	Dye making	1	750	750
	Cutting & Folding cost	25	5	125
Overhead charges				300
Total				**4,876.75**

25 smart packages

8. CONCLUSION

Thus, the paper concludes that the integrated system will be more efficient in conveying or delivering the information to the target people. These smart packages can be adapted in all types of medical packages that need to be monitored and provide guidance for low vision people and old people etc.

This project, is made with pre planning, that it provides flexibility and economical in operation. This innovation has made more desirable and economical. This smart label helps the manufactures and the customers in larger way. This project taught us about the stages involved in finishing a project. Thus, we have completed our project successfully.

9. FUTURE ENHANCEMENT

Every work has a development and thus we have decided to further develop our project by adding even more user-friendly options. Some of our ideas for future work are:

Developing even more flexible smart packages for various products. By using Nano technology, we can reduce the size of the components and make it more flexible. Including IOT applications in the package/labels to make it more interactive.

10. REFERENCES

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