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SMART PRINTING CUM BINDING MECANISM

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Abstract : Printing question papers in multiple pages and stapling them is a tedious task. With human errors it is difficult to plot the empty pages which may be stapled during the mass printing and binding. This is a time consuming task. This project deals with the development of the automated smart binding approach which uses automated system for picking one page at a time from multiple trays and stapling them in order to generate a bided print. The system also uses OCR techniques to verify the order of bind by using template matching and OCR to make sure mistakes are eliminated. This project proposes a smart printing cum binding system which is developed in the form of the attachment to the printer. The proposed system consists of multiple trays to hold individual paper in order and a camera top to verify the contents using OCR. When activated the paper loading mechanism will pick one paper from every tray, verify the print on the paper using OCR and template matching and then proceed to binding to staple them together. The proposed setup is completely automated to repeat the cycle with minimum errors. The system is built up around Raspberry pi as base board interfaced to camera for OCR and Stepper Motors for Automation.

IndexTerms **– Printing, Binding, OCR, Template matching, Raspberry pi, Stepper motor, Automation.**

1. INTRODUCTION

In recent times, services have introduced numerous technological developments, which have had a huge effect on the work setting and productivity. Printing and binding system has come a long way along with the appearance of technologies. The question paper or ordered document printing requires collecting one paper at a time and also binding it in order. The manual system is error prone and requires time. The time is consumed to collect, validate, bind and do with manual approach. With the OCR ways getting better and better every day the manual approach can be converted to automated ones with the implementation of OCR and template matching for order verification and mechatronic based system for picking up one paper at a time from a tray and coming it to binding. This design proposed an automated setup for the same.

2. Literature Survey

Before we start with the project a brief literature review was carried to arrive at the problem definition. A number or research papers were studied to arrive at the scope. The problems definition and the currently followed approaches were studied to arrive at the problem definition. The research work of some the research scholars is given in this chapter.

- ✓ In Ref. [1], auto document feeding (ADF) was proposed with a low cost automatic A4 page scanner. As compared to the existing scanners this was very much cost effective and can be used in various fields to work effectively.
- ✓ In this Ref. [2], Alotaibi, F., Abdullah, M. T., Abdullah, R. B. H., Rahmat, R. W. B. O., Hashem, I. A. T., & Sangaiah, A. K. (2018) IEEE Access, 6, 554-562. They gave Optical Character Recognition for Quranic Image Similarity Matching.
- ✓ Using an electro adhesive force concept in Ref. [3], author introduced an automatic page-turning device that reduced the complexity of turning pages and image processing as well.
- ✓ The approach in Ref. [4] was towards Multi-Function Printer using raspberry Pi for Professional Institutions. Its operating speed was high and can be used in the institutions professionally.
- ✓ In Ref. [5], Tamim, R. A., Bappy, M. H., In 2018 21st International Conference of Computer and Information Technology (ICCIT) they gave auto document feeding, was proposed with a low cost automatic A4 page scanner. As compared to the existing scanners this was very much cost effective and can be used in various fields to work effectively.

3. BLOCK DIAGRAM

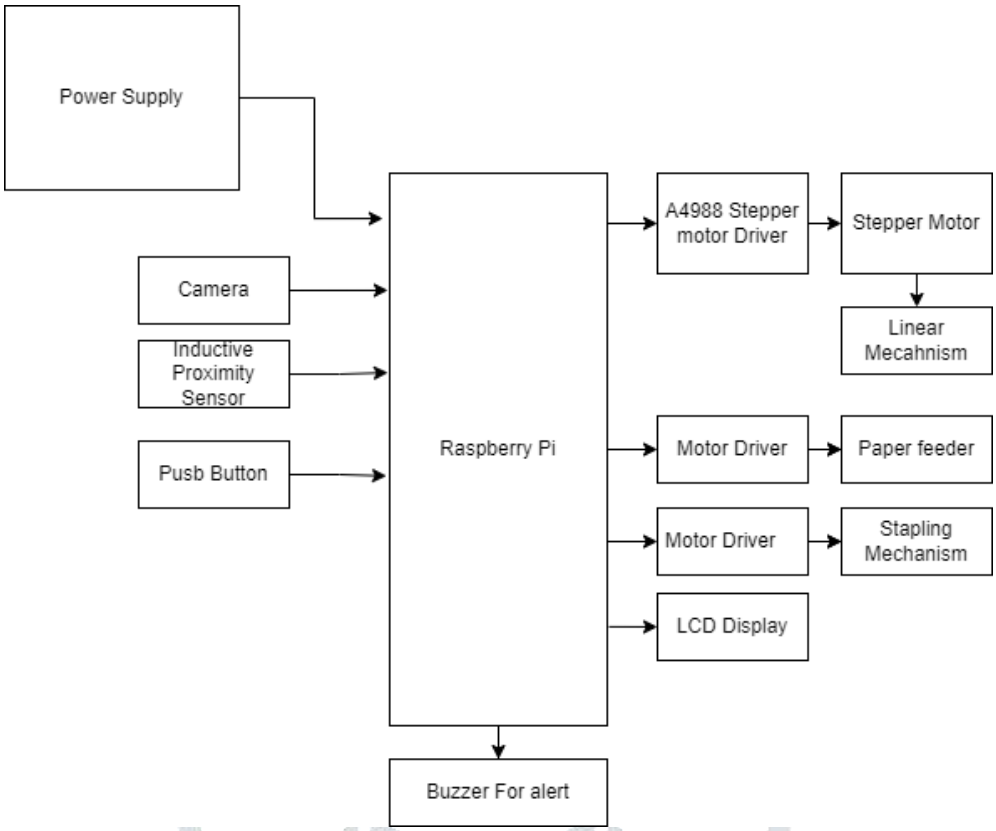


Fig.3 Block Diagram of Smart Printing Cum Binding Mechanism

4. CIRCUIT DIAGRAM

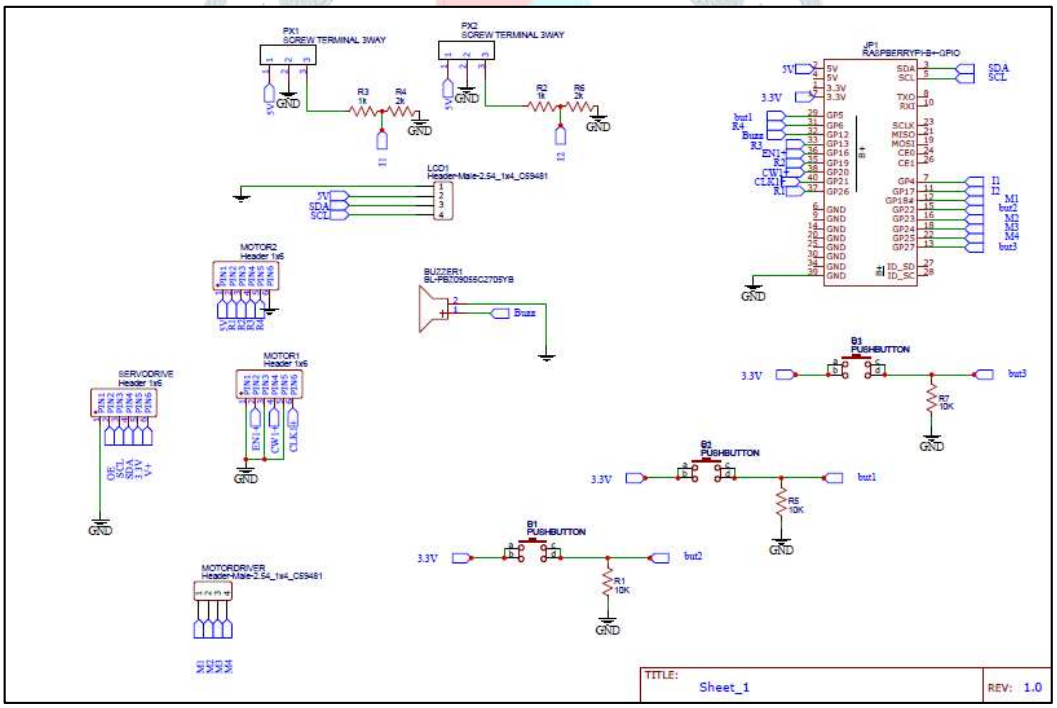


fig 4. circuit diagram of Smart Printing Cum Binding Mechanism

5. FLOW CHART OF SMART PRINTING CUM BINDING MECHANISM:

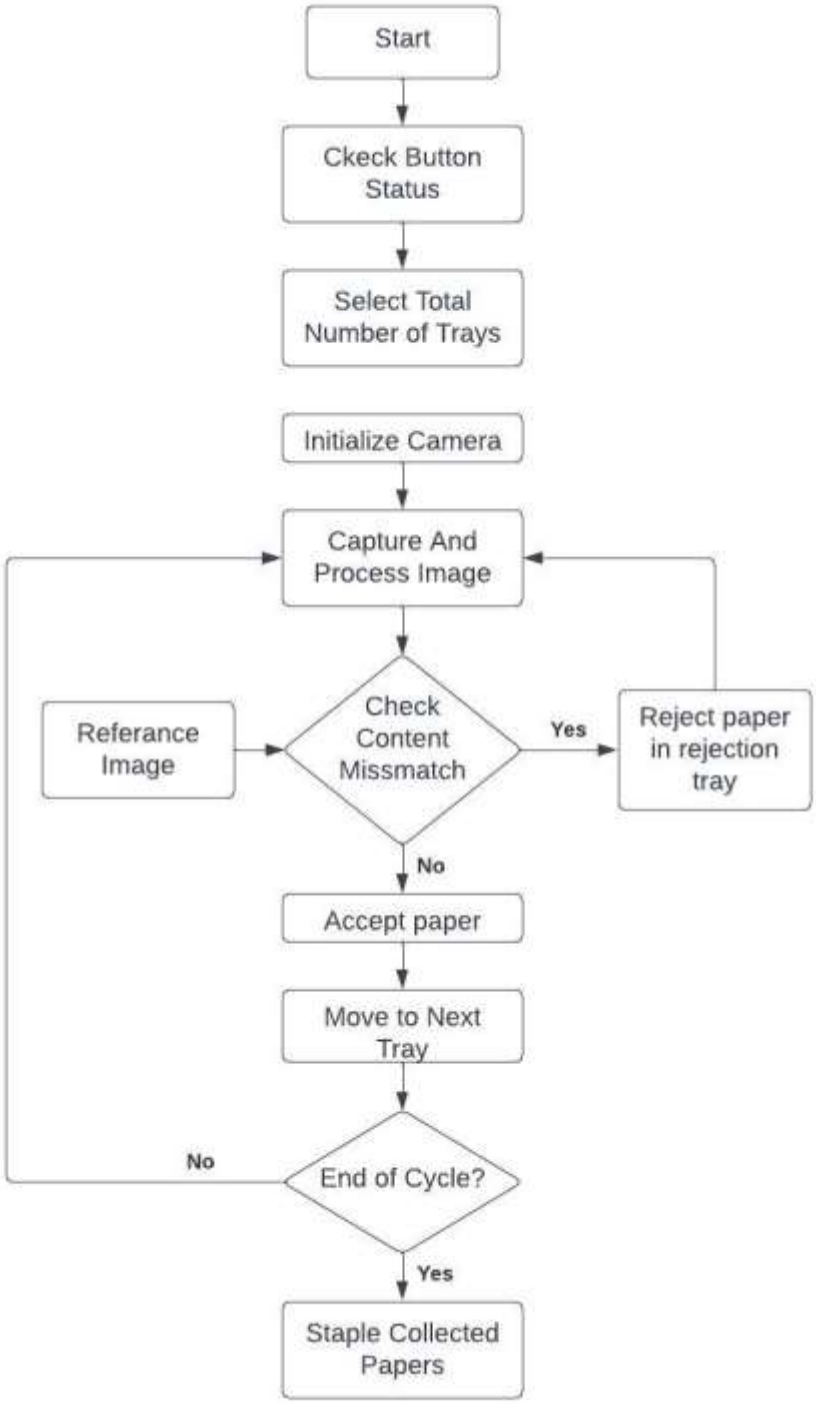


fig. 5 flowchart

6. WORKING OF SMART BINDING MECHANISM SYSTEM.

Fig.6 Implemented Smart Binding Mechanism.

There are several steps in designing of smart printing cum binding mechanism:

- Analysing the problem statement.
- Market survey of material availability and costing.
- Selection of material to make a module
- Designing basic structure of the project.
- Assembling every module.
- Designing final mechanism.
- Hardware checking and testing.
- Final result.

7. PROPOSED WORK

1) SOFTWARE PART :

A typical Implemented system is made up of two processing components:

(A) Optical Character Recognition(OCR).

(B) PyCharm IDE

A. OPTICAL CHARACTER RECOGNITION:

Interfacing camera to Raspberry pi and implement OCR and Template matching:

In this phase the camera based system is developed to verify the order of the paper and also to verify if the paper is blank. The camera is interfaced to the raspberry pi to check if the paper is blank. If the paper is blank the mechanism will automatically reject that paper before proceeding further. The camera also captures the image of the paper before collection and performs OCR to determine if the content of the paper matches with the order or template and then proceeds to the binding or the next tray.

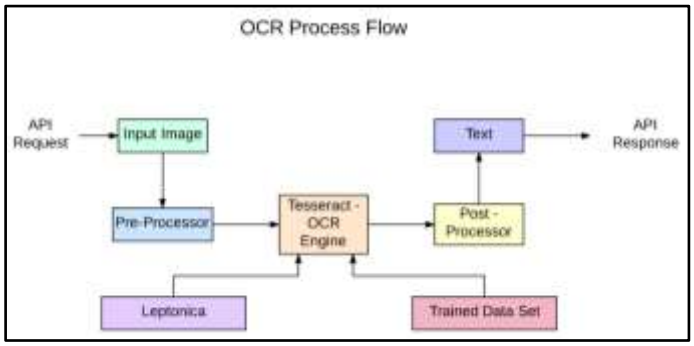


Fig.7 OCR Process Flow to build API with Tesseract

B. PyCharm IDE:

The programming of the entire system is done in python. The Python is a widely used high-level programming language for general-purpose programming. In our project we are using PyCharm ide for compiling the python programs, to communicate with stepper motor, dc motor, stepper motor driver, dc motor driver, Arduino mega, etc. through raspberry pi. Python is very simple language to learn as well as the coding purpose. We use this language because raspberry pi has its own python IDE.

2) HARDWARE PART:

1. Raspberry Pi 3

Raspberry Pi 3 is a heart of project, it always be at a centre. In case of our project raspberry pi is a processing unit. It controls DC motor, proximity sensor, camera module, solenoid valve, guide rail etc.

2. Raspberry Pi camera Module:

The 5MP Raspberry Pi 3 Model B Camera Module with Cable equips flexible cable for attaching with Raspberry Pi 3 Model B.This camera will plug directly into the Raspberry Pi 3 Model B camera port! In case of our project camera module is used to capture the image present in the feeding treys, and its checks the content present on the paper by optical character recognition (OCR) technique.

3. Arduino Mega:

The **Arduino Mega 2560** is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. In case of our project we use Arduino mega for requirement of some extra port because we can't connect all components directly to raspberry pi.

4. Solenoid Valve:

When we feed one paper for checking the contents at that time due to high pressure of DC motor some extra papers are also come with this single paper. To avoid this accident we use solenoid valve. The working of solenoid valve in our project to hold the other paper by strong pressing.

5. Proximity sensor:

Proximity sensors are types of sensors that are used to detect nearby objects without coming into physical contact.
In case of our Project we use proximity sensor to check position of moving tray because we have to know the position of moving tray to feed the paper or reject the paper.

6. LCD Display:

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits &devices like mobile phones, calculators, computers, TV sets, etc.
In case of our project we use LCD display to show smart binding system and processes like initializing wait, process done etc.

8. RESULTS

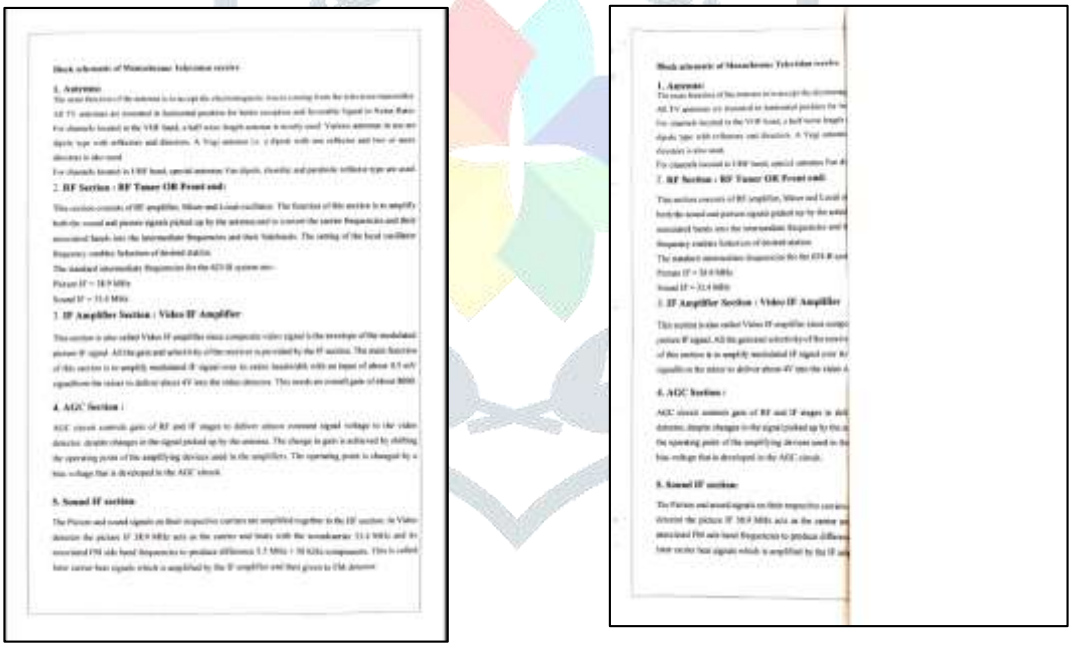
8.1 On Lcd display: smart binding system and tray selection using push buttons.

Fig.8.1 Message displayed on LCD and selection of tray using push buttons.

We use LCD display which is interfaced with raspberry pi to show the initialization of project and also it display message the project is ready to run. After displaying this message we can push the cycle start button.

The system consists of multiple trays, the settings regarding trays are taken into account using the setup provided and hardware interfaced to select the number of trays using the push buttons. Once the initial setting are set the system then gets activated in the repeat loop mode.

8.2 Reference image captured by camera.



Reference Image **Captured Image**

Fig.8.2 Content Mismatch

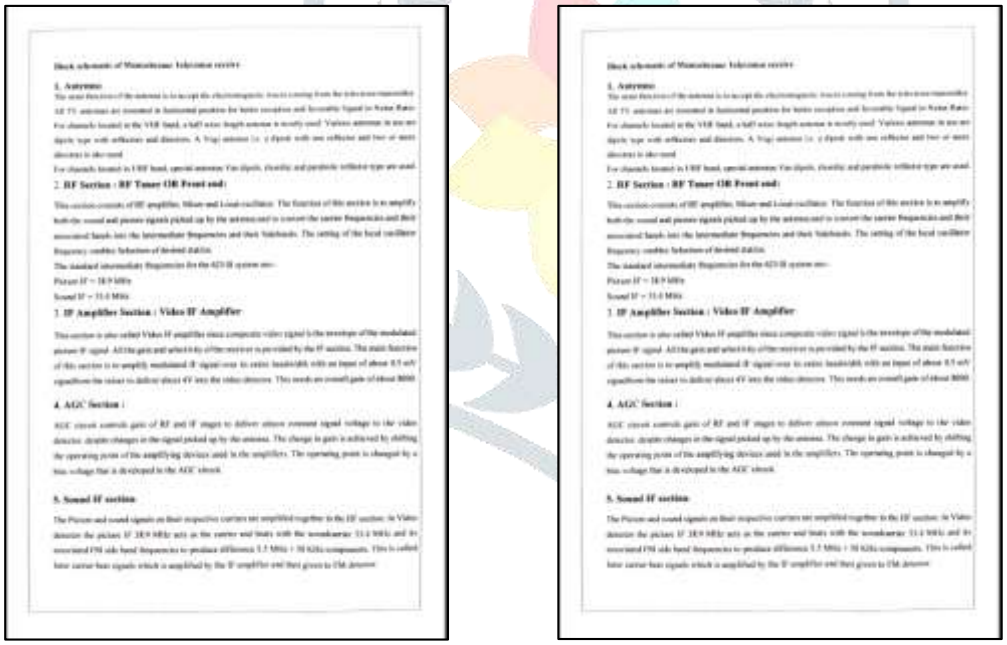
The main purpose of our project is to recognize the characters. The camera capture the reference image and check the content are present or not. When the contents are mismatched (Fig 8.2) with reference image, then collection tray moves from 1st to 2nd position and it will reject the paper.

8.3 Paper rejects after the content Mismatch.

Fig.8.3 Rejection of paper.

The camera capture the image and check the content are present or not and check whether the contents are matched with reference image.
When the contents are mismatched, the message is sent to the raspberry pi then it will automatically reject the paper.

8.4 Paper feed after the content match.



Reference Image **Captured Image**

Fig.8.4.1 Content match

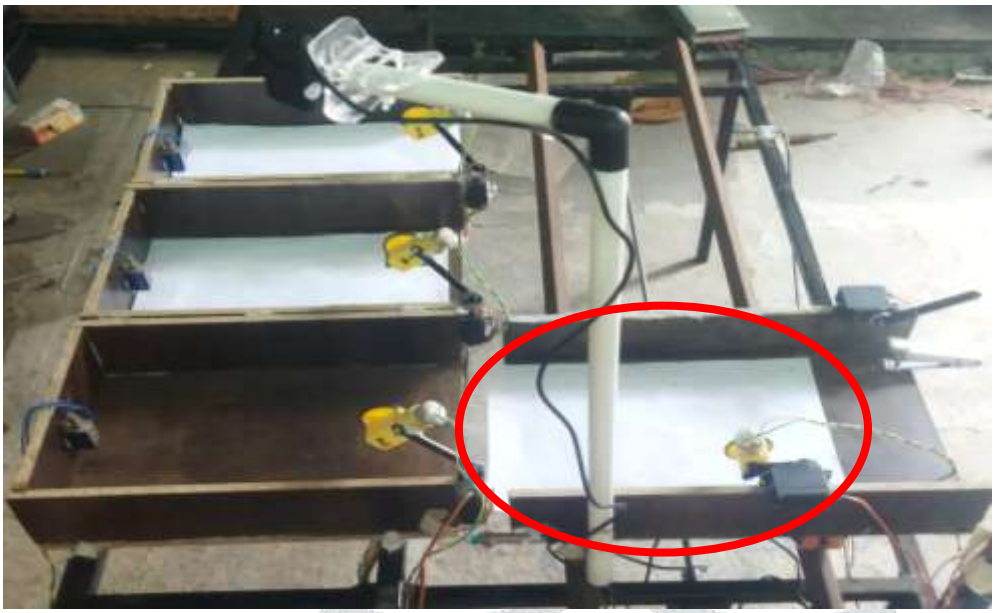


Fig.8.4.2 Paper feeding.

Content of the paper is checked using the overhead camera. When the contents are matched(Fig.8.4), the message is sent to the raspberry pi and the feeding mechanism feeds the paper(Fig.8.5). It consist of DC motor and stepper motor. It will feed the single paper at a time and remaining bunch of paper is pressed through the solenoid valve.

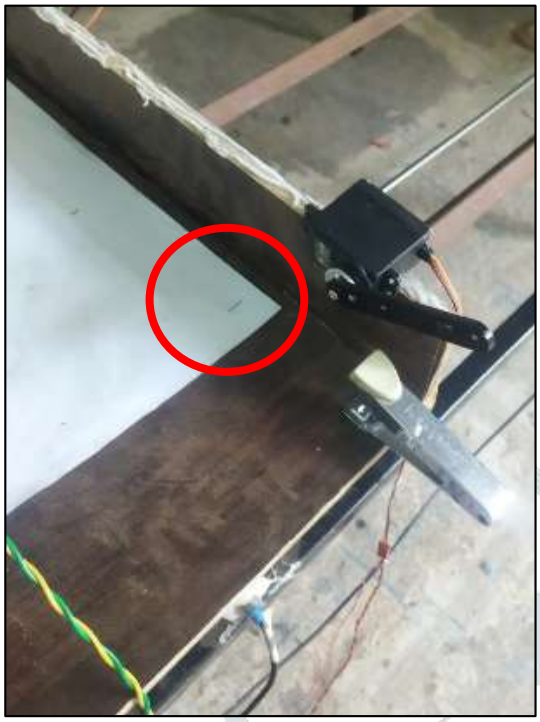
8.5 Tray Moved to the last Position and staple the papers.

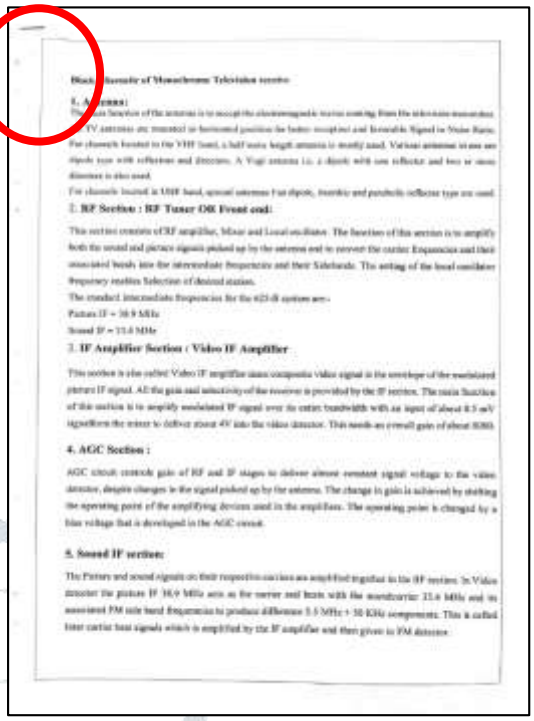
Fig.8.5 Tray Moved to the last Position and automatic staple the papers.

After checking the position through sensor, the moving tray are at the 3rd position to collect the paper. Before collection of the paper from tray the content of the paper is checked using the overhead camera to match with the template to verify if the paper is blank or in right order using template matching.

The system then automatically moves from tray to tray to collect one paper at a time after verifying it and takes it to stapling mechanism. The paper then is stapled to bind it and the cycle repeats.

8.6 Final outcome of smart printing cum binding mechanism.





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10.CONCLUSION

The implemented project is to collect papers one by one and bind them automatically. The implemented system has facility to select the number of trays previously in advance then it efficiently collect all papers together and bind. It also has the facility to minimize human errors occurred in traditional binding system. It separate blank , mismatched papers hence it provide efficient, less time consuming binding mechanism which will helpful for offset workers. Which definitely beneficial for the society.

11. REFERENCES

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