SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-572103

(An Autonomous Institute under Visvesvaraya Technological University, Belagavi)

Project Report
on

"Booklet Lifting Machine For Scanning The Internal Assessment Marks"

submitted in partial fulfillment of the requirement for the completion of VI semester of

BACHELOR OF ENGINEERING

in

ELECTRONICS & COMMUNICATION ENGINEERING

Submitted by

Abhishek U	1SI18EC006
Ananya S J	1SI18EC011
Deeksha B J	1SI18EC029
Mohammed Rafi	1SI18EC056

under the guidance of

Dr. V M Aparanji

Assistant Professor

Department of E&CE

SIT, Tumakuru-03

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

2020-21

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-572103

(An Autonomous Institute under Visvesvaraya Technological University, Belagavi)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

CERTIFICATE

Certified that the mini project work entitled "BOOKLET LIFTING MACHINE FOR SCANNING INTERNAL ASSESSMENT MARKS" is a bonafide work carried out by Abhishek U (1SI18EC006), Ananya S J (1SI18EC011), Deeksha B J (1SI18EC029) and Mohammed Rafi (1SI18EC056) in partial fulfillment for the completion of VI Semester of Bachelor of Engineering in Electronics & Communication Engineering from Siddaganga Institute of Technology, an autonomous institute under Visvesvaraya Technological University, Belagavi during the academic year 2020-21 It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the department library. The Mini project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the Bachelor of Engineering degree.

Dr.V M Aparanji
Assistant Proffesor
Dept. of E&CE
SIT, Tumakuru-03

Head of the Department
Dept. of E&CE
SIT, Tumakuru-03

External viva:

Names of the Examiners **Signature with date**

1.

2.

ACKNOWLEDGEMENT

We offer our humble pranams at the lotus feet of **His** Holiness, **Dr. Sree Sree Sivakumara Swamigalu**, Founder President and **His** Holiness, **Sree Sree Siddalinga Swamigalu**, President, Sree Siddaganga Education Society, Sree Siddaganga Math for bestowing upon their blessings.

We deem it as a privilege to thank **Dr. M N Channabasappa**, Director, SIT, Tumakuru, **Dr. Shivakumaraiah**, CEO, SIT, Tumakuru, and **Dr. S V Dinesh**, Principal, SIT, Tumakuru for fostering an excellent academic environment in this institution, which made this endeavor fruitful.

We would like to express our sincere gratitude to **Dr. R Kumaraswamy**, Professor and Head, Department of E&CE, SIT, Tumakuru for his encouragement and valuable suggestions.

We thank our guide **Guide's name**, Designation, Department of Electronics & Communincation Engineering, SIT, Tumakuru for the valuable guidance, advice and encouragement.

Abhishek U	(1SI18EC006)
Ananya S J	(1SI18EC011)
Deeksha B J	(1SI18EC029)
Mohammed Rafi	(1SI18EC056)

Course Outcomes

CO 1 : Identify , formulate the problem and define the objectives

CO 2 : Review the literature and provide efficient design solution with appropriate consideration for societal, health and safety issues

CO 3 : Select the engineering tools/components and develop an experimental setup to validate the design

CO 4 : Test, analyse and interpret the results of the experiments in compliance with the defined objectives

CO 5 : Document as per the standard, present effectively the work following professional ethics and interact with target group

CO 6 : Contribute to the team, lead the diverse team, demonstrating engineering and management principles

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3												3	
CO-2		2				1							2	1
CO-3			2		2							2	2	2
CO-4				2			2							2
CO-5								2		2		2		2
CO-6									2		1			1
Average	3	2	2	2	2	1	2	2	2	2	1	2	2	2

Attainment level: - 1: Slight (low) 2: Moderate (medium) 3: Substantial (high)

POs: PO1: Engineering Knowledge, PO2: Problem analysis, PO3: Design/Development of solutions, PO4: Conduct investigations of complex problems, PO5: Modern tool usage, PO6: Engineer and society, PO7: Environment and sustainability, PO8: Ethics, PO9: Individual and team work, PO10: Communication, PO11: Project management and finance, PO12: Lifelong learning

Abstract

Today everyone is living in digital era, where every aspect of life is becoming digital. It is true for reading books, papers, and journals etc. However, test booklets in universities are in analog format. To convert those test booklets to digital format, a scanner is required. Scanner scans and stores the data for future use. Accordingly, if the scanner feed takes the booklets automatically, it will be much easier process. Digital data can be easily distributed, reproduced and read on screen. Scanning the bundle of booklets would definitely increase the workload and consume lot of users time. The problems like limited physical storage, scanning bundle of books by manual flipping will be tedious process. Many techniques have been developed to flip and scan the booklets automatically, but they all differ in design, mechanisms, specifications, quality etc.

"Booklet lifting machine to scan internals assessment booklets" act as one of the support systems of automatic scanning. Here, the pile of booklets is positioned on a tray and then the tray is lifted. There are many mechanisms to lift the loads like scissor lifting, pneumatic lifting, linear actuators etc. Use of linear actuator simplifies the work compared to other methods. The motors are connected to Raspberry pi, which is used to lift the tray containing booklets. After lifting, the front sheet of the booklets gets captured by a Raspberry Pi camera. The scanned data will be converted into an electronic form and it is stored in the memory. Through implementation of scanning, accessibility of data is rapid and a lot of time is saved. After scanning the booklet, it is driven out of the tray using rollers. A last page detector (IR sensor) is used for detecting the last booklet and gives feedback to controller by displaying a completed command. Hence, all the physical documents are converted into digital format automatically.

This automatic booklet lifting and scanning machine is used in educational institutes to automatically lift and scan the internal booklets and quiz papers. Brings automation in the educational field and eases the work. In libraries, used to scan the book numbers so that it can be placed in right rack.

Contents

List of Figures

Chapter 1

Introduction

In the last few years, the need for automation has increased rapidly because of the rising request from both academic and business organizations. With reference to the college academics, digitalization of answer booklets, marks card is very much needed in order to reduce the human efforts. Scanning creates much simpler electronic version of the documents which can be used for assessment purpose.

Book Scanning is the process of converting physical books into digital media such as images,electronic text, or electronic books (e-books) by using an image scanner. Digital books can be easily distributed, reproduced, and read-on screen.

1.1 Motivation

After conducting the examinations, there comes a crucial task of documenting the answer booklets which must be done precisely on time. Scanning the bundle of booklets by manual flipping increase the workload and consume a lot of time of the user. To address the above-mentioned issue, this project presents an approach to scan a pile of booklets with automation and database storage. Recently, many techniques have been developed to flip the booklets automatically, but they all differ in design, specifications, speed and quality. Some of the techniques are by using vacuum lift mechanism, finger flipping technique having roller and slider etc. Auto Document Feeding (ADF) scanner is the one that scans pages automatically. It takes several pages at once and feeds the pages one after the other into scanner and thereby store the scanned copy as PNG/JPEG or PDF. But in this project the pile of booklets is placed, then the front sheet of the booklet is captured by the camera and sent out through rollers. This process repeats till all the booklets are scanned.

1.2 Objective of the project

The main objective of the project is:

• To design a model which can automatically lift, scan and place the answer booklets

with less human effort.

• To scan the front sheet of the answer booklet and storing the image in the system for future use.

• To send "no booklet" signal to the microcontroller through the IR sensor once the process is completed.

1.3 Organisation of the report

The report is divided into 4 chapters. In chapter 2, the literature review on booklet flipping and scanning techniques, lifting tools, edge detection techniques are presented. In chapter 3, the block diagram of the system and the hardware and software description of the model are presented. In chapter 4, the work carried out so far and the future plan of actions of the project are presented.

Chapter 2

Literature Review

This chapter includes summary of the findings/surveys that are carried as a groundwork for the project.

Processing the scanned image require image edge detection technique. There are few types of edge detection algorithm used, which include Roberts' edge detection, Perwitt edge detection, Sobel edge detection, Laplacian of gaussian edge detection and canny edge detection. Considering the advantages and disadvantages of all the techniques, it is found that the second order derivation (canny edge detection) works well with image cropping [2].

There are two kinds of page turning mechanism for scanning process. Destructive and non-destructive types, where destructive book scanners cut books into sheets of paper and scan using ADF and non-destructive types, uses turning and imaging each page. These are demonstrated by roller structures, vacuum pumps, page turner heads. Considering the working. Non-destructive type of turning mechanism is used [3].

High-speed book digitization is vital technology which put a firm impact in many fields, like storing documents. A vital technology that made important growth under this situation, called Book Flipping Scanning, has been introduced. This is a new method of scanning books in which all pages of a book are captured while pages are continuously flipped automatically through the page turner without stopping at each page. Many systems introducing this concept are introduced and developed to reach the different requirements in different markets, a high-speed camera system and a portable system using a single camera.

The performances of three kinds of book flipping scanners are reviewed. The kirtas APT Book scan 1200 has developed fully automated device that scans and digitize books at

rate of 1200 pages per hour which uses the operation of kirtas technology. Low over-head Manipulation of bound book pages this article describes new method for one sided, non-prehensile paper manipulation problem in which we use polydimethylsiloxane to create mechanical bond between the paper and robot manipulator. The robot has scan pages 10720 at 0.056 percent error rate. Automatic page turner machine for high-speed book digitization. This article achieved almost 100 percent success rate for turning pages at rate of 300 pages per min [4].

The importance of automatic scanning in educational and business organizations. Scanning is an act of methodically moving a beam of light over a surface to capture an image. Converting paper documents into an electronic form. Commercially available scanning devices, however, do not have the ability for automatic scanning of bound books. Human interface to flip the pages by hand becomes mandatory and this process would consume time and effort. Through the improved implementation of scanning, companies have gained more rapidly access to information and saved time and costs coupled with business operations [5].

There are different types of lifting mechanisms that is used for automation. This includes scissor lifting, pneumatic lifting, linear actuator. Scissor lifting is height limited and in pneumatic lifting, precise position control is impossible. To overcome these disadvantages, linear actuator is used. It is a mechanism which translates turning motion to linear motion and has large load carrying capability, smooth and low maintenance. Parameters like height of the platform, weight of the load, and type of load are considered for lifting mechanism [6].

This chapter discussed about the literature survey carried out for the project regarding lifting mechanisms, flipping techniques and different kinds of edge detection techniques to crop the images. The survey carried out has given insight about the advantages and disadvantages of different lifting techniques and edge detection algorithms.

Chapter 3

System overview

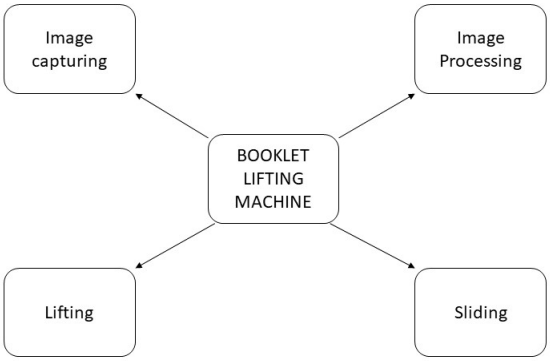


Figure 3.1: System Overview

The block diagram of the proposed system is shown in Figure 3.1. It consists of four main blocks, each represents a mechanism or algorithm. The blocks are namely, image Capturing, image Processing, lifting and sliding.

Image Capturing: Front sheet of the internal booklets are captured using camera.
Image Processing: Captured images are processed in required format.
Lifting: Booklet holder is lifting in increment to have a clear capturing of image.
Sliding: After each booklet is scanned, it is pushed down.

Chapter 4

System Hardware

The block diagram of the proposed system is shown in Figure 4.1. and the model overview is seen in Figure 4.2. It consists of power supply, raspberry pi, camera, motors, motor controllers and IR sensor.

This block diagram works as follows: After placing booklets in a holder, IR sensor detects if the holder has booklets and sends signal to raspberry pi. Raspberry pi signals camera to take snapshot of the front sheet and is saved in the storage. Raspberry pi signals the servo motor to sweep in order to move the BO motors with wheel to the required position and it slides down the scanned booklet with the help of wheels. Then send signal to stepper motor to lift the booklet holder. This process continues till IR sensor displays "no booklets". The stored images are cropped and processed using image processing and stored in the PC. Further these images are sent through mail in PDF format.

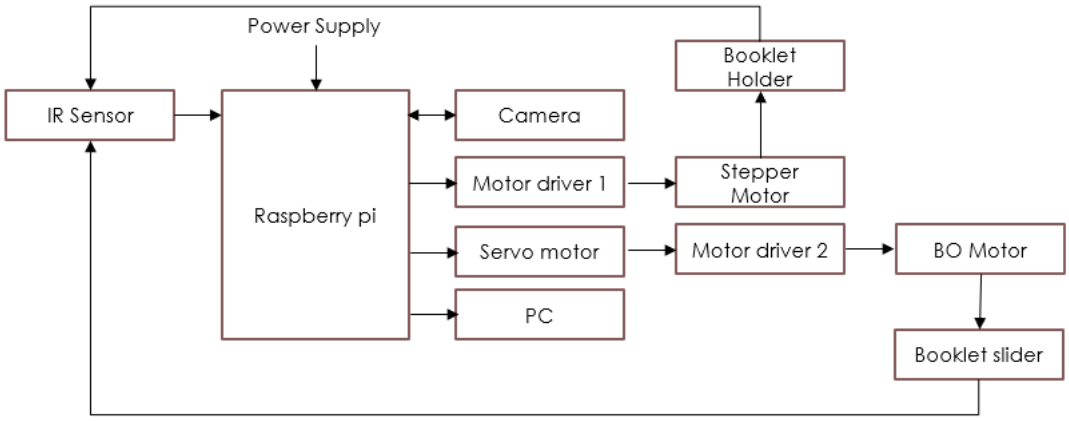


Figure 4.1: Booklet Lifting Machine

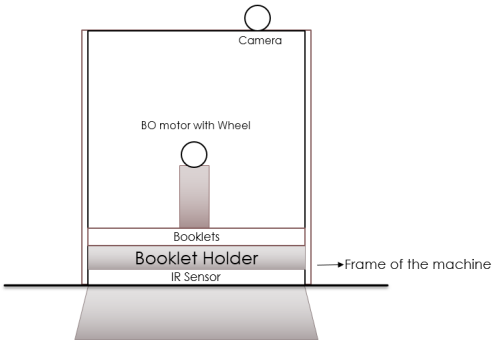


Figure 4.2: Model overview

4.0.1 Raspberry PI

Raspberry pi 3B model, as shown in Figure 4.3 is used in this project. It controls motors, camera and IR sensor.

• It is a small, powerful and lightweight ARM-based computer.

• It is a 64-bit processor, 1.2 GHz Quad-Core system on a chip, which is built on the ARM Cortex-A53 based architecture.

• It has 1GB of RAM.

• It includes on-board 802.11 WiFi and Bluetooth 4.0.

• It comes with Micro USB socket 5V, 2.5A rating, Audio Output jack of 3.5mm, four USB slots, one HDMI port and one Ethernet socket.

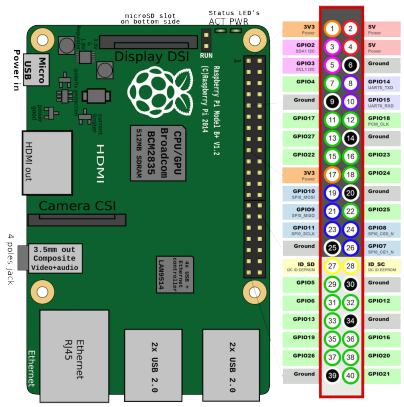


Figure 4.3: Raspberry Pi pin-out diagram

4.0.2 Camera

Raspberry pi camera shown in Figure 4.4 is used to capture the front sheet of answer booklets.

It's an 5MP camera exclusively made for Raspberry PI and can take 1080p high-definition videos. Its small in size and can be directly connected to the PI board.

Features of PiCamera:

• Fixed focus lens on-board

• Improved resolution - 5 mega pixel native resolution sensor-capable of 2592 x 1944 pixel static images

• Size 20mm x 25mm x 9mm

• Weights over 3g

• Connects to the Raspberry Pi board via a short ribbon cable (supplied)

• Camera v2 is supported in the latest version of Raspbian, Raspberry Pi's preferred operating system

• Uses the Sony IMX219PQ image sensor - high-speed video imaging and high sensitivity

• 1.4m X 1.4m pixel with Omni BSI technology for high performance (high sensitivity, low crosstalk, low noise)

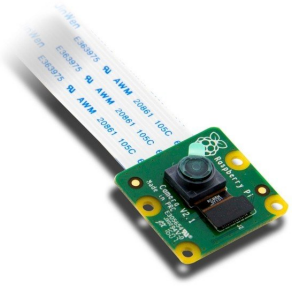


Figure 4.4: Raspberry Pi camera

4.0.3 Motors and Motor drivers

Motors are used to lift the booklet holder and to roll down the scanned booklet.

4.0.4 Stepper Motor

NEMA17 4.2 kg-cm Stepper motor shown in Figure 4.5 is used to lift the booklet holder. These motors has a step angle of 1.8 deg., this means that it has 200 steps per revolution for every step it will cover a 1.8° hence the level of control is also high.

Features:

- Rated Voltage: 12V DC
- Current: 1.2A at 4V
- Step Angle: 1.8 deg
- No. of Phases: 4
- Motor Length: 1.54 inches
- 4-wire, 8 inches lead
- 200 steps per revolution, 1.8 degrees

Figure 4.5: Stepper Motor

4.0.5 BO Motor

BO motor with wheel is shown in Figure 4.6. It is used to push the booklets after it is scanned. It is light in weight and capable to absorb shock and vibration.

It has relatively low co-efficient of friction. Its operating voltage is 3V-12V and rated speed is 100RPM.

Figure 4.6: BO motor

4.0.6 MG995 servo Motor

MG995 Metal Gear Servo Motor shown in Figure 4.7: is a high-speed standard servo can rotate approximately 120 degrees (60 in each direction).It is a digital metal gear high torque servo for airplane, helicopter, RC-cars and many RC model.

Features of Servo motor:

- 4.8V - 7.2V DC Operating voltage
- Control system: Analog
- Operating Speed : 1) 20sec / 60 deg (4.8V no load)

2) 16sec / 60 deg (6.0V no load)

- Weight : 55g
- Operating Angle : 120degree

Figure 4.7: mg995 Servo motor

4.0.7 L293D motor driver module

L293D motor driver module shown in Figure 4.8 is used to drive the BO motor. A motor driver is an integrated circuit chip which is usually used to control motors. These ICs are designed to control 2 motors simultaneously. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. This IC has 16 pins.

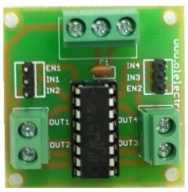


Figure 4.8: L293D motor driver module

4.0.8 L298N motor driver module

L298N motor driver module shown in Figure 4.9 is used to drive the stepper motor. L298N module has two H-Bridges, each H-Bridge will drive one of the electromagnetic coils of a stepper motor. By energizing these electromagnetic coils in a specific sequence, the shaft of a stepper can be moved forward or backward precisely in small steps.

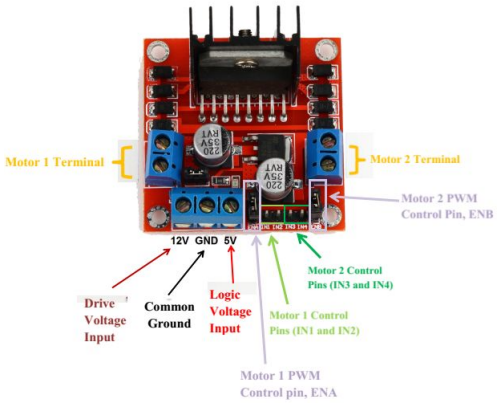


Figure 4.9: L298N motor driver module

4.0.9 IR Sensor

The IR sensor is shown in Figure 4.10 is used for detecting the last booklet and send signal to raspberry pi to stop the process. The IR sensor module consists mainly of the

IR Transmitter and Receiver, Op-amp, Variable Resistor, output LED.

Features of IR sensor:

- 5VDC Operating voltage
- I/O pins are 5V and 3.3V compliant
- Adjustable Sensing range
- Built-in Ambient Light Sensor
- 20mA supply current

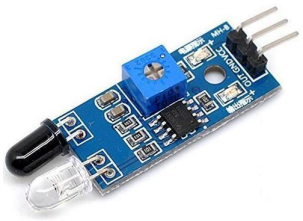


Figure 4.10: IR Sensor

4.0.10 PC

The scanned image is saved into storage of PC.

4.0.11 Power Supply

5V, 2A power adapters are used to power up raspberry pi. A 9V power adapter is used to supply power to the LED strips. 12V regulated DC supply for servo motor and BO motor.

Chapter 5

System Software

5.1 Software Description

5.1.1 Flowchart

The overview of the project is shown in the Fig 5.1, the booklets are loaded on a booklet holder then IR sensor detects the holder has booklets and send signals to raspberry pi. If the signal sent from the detector is off then camera takes the picture later slides out the booklet and booklet holder is lifted. If the signal from the detector is on then it sends no booklets information then later pictures stored in the raspberry pi will be taken for image processing and cropped. Then processed images are stored in the database.

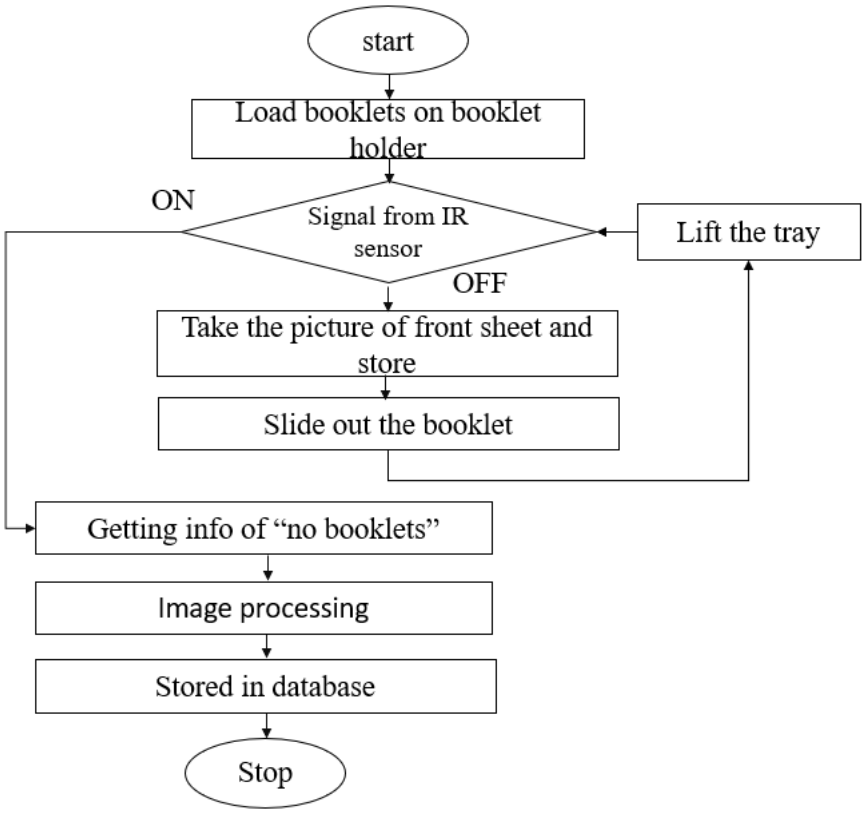


Figure 5.1: Flowchart

5.1.2 Raspbian OS

It's the Raspbian pi module's operating system, which comes preloaded with a suite of basic apps and utilities. It comes with surfing, python scripting, and a graphical user interface (GUI) desktop. Raspberry Pi OS resembles many popular desktop operating systems, such as macOS and Microsoft Windows.

5.1.3 Python Programming

Raspberry pi code is written using python programming language.

5.1.4 Open CV

It is a cross-platform library using which can develop real-time computer vision applications. It focuses on image processing, video capture and analysis including huu features like object detection.

5.1.5 NumPy

It is a python language library which supports huge multi-dimensional arrays and matrices, along with a wide collection of high-level mathematical functions to operate on these arrays.

5.1.6 SciPy

It is an open-source core package that is widely used for technical computations. It builds efficiently on NumPy stack which includes tools like matplotlib, pandas and SymPy and an expanding set of scientific computing libraries.

5.1.7 Canny Edge Detection

The Canny edge detector is an edge detection operator that detects a wide range of edges in images using a multi-stage approach.
This approach requires that the image be converted to gray scale.

The Canny edge detection algorithm is composed of 5 steps:

1. Noise reduction
2. Gradient calculation
3. Non-maximum suppression
4. Double threshold
5. Edge Tracking by Hysteresis

5.1.8 Pillow-PIL

1. Used to process the edged detected image.
2. Used in Filtering of image.
3. This library Supports image resizing and rotation.
4. It has Automatic contrast enhancement feature.

5.1.9 Import libraries

picamera

The Raspberry Pi camera module for Python has a pure Python interface provided by this package.

fpdf

FPDF is a PHP class that allows to create PDF files using only PHP, rather than the PDFlib library.

Features:

1. Choice of measure unit, page format and margins
2. Page header and footer management
3. Automatic page break
4. Automatic line break and text justification
5. Image support (JPEG, PNG and GIF)
6. Page compression

gpiozero

This library provides simple interface to GPIO devices with raspberry pi.
servo is a module in this library which is used for interfacing servo motor with pi.

5.1.10 SMTP

"smtplib" creates a Simple Mail Transfer Protocol client session object which is used to send emails to any valid email id on the internet.
This code can send plain text emails with no attachments or subject lines.
SMTP (Simple Mail Transfer Protocol) is a push protocol and is used to send mail where as POP and IMAP are used to retrieve those mails at the receiver side.
It is a application layer protocol.The client who wants to send the mail opens a TCP connection to the SMTP server and then sends mail across the connection. It is always on listening mode. As soon as it listens for a TCP connection from any clients, the SMTP process initiates a connection through port 587.

5.1.11 MIME

It is Multipurpose internet mail extension protocol. Since SMTP has a very simple structure, it can only sends messages in 7 bit ASCII format. It cannot be used to send language like German, Japanese etc.
So to make SMTP more broad, MIME is used. It can send binary files, video and audio data. It is able to send multiple attachments with a single message and has unlimited message length.

Chapter 6

Experiment and Result

6.1 Process

The architecture of the model and the components are set up as in the shown Figure 6.1. Output of the process in the raspberry pi terminal shown in Figure 6.2. The booklets are loaded on a booklet holder then IR sensor detects if the holder has booklets and send signals to raspberry pi. If the signal sent from the detector is off then camera takes the picture later slides out the booklet and booklet holder is lifted. If the signal from the detector is on then it sends "No booklets found" information then later pictures stored in the raspberry pi will be taken for image processing and cropped by showing the output print statement as "Process 1 to n". Then processed images are stored in the database.The processed image is sent to mail in the form of pdf.

Figure 6.1: Model Architecture

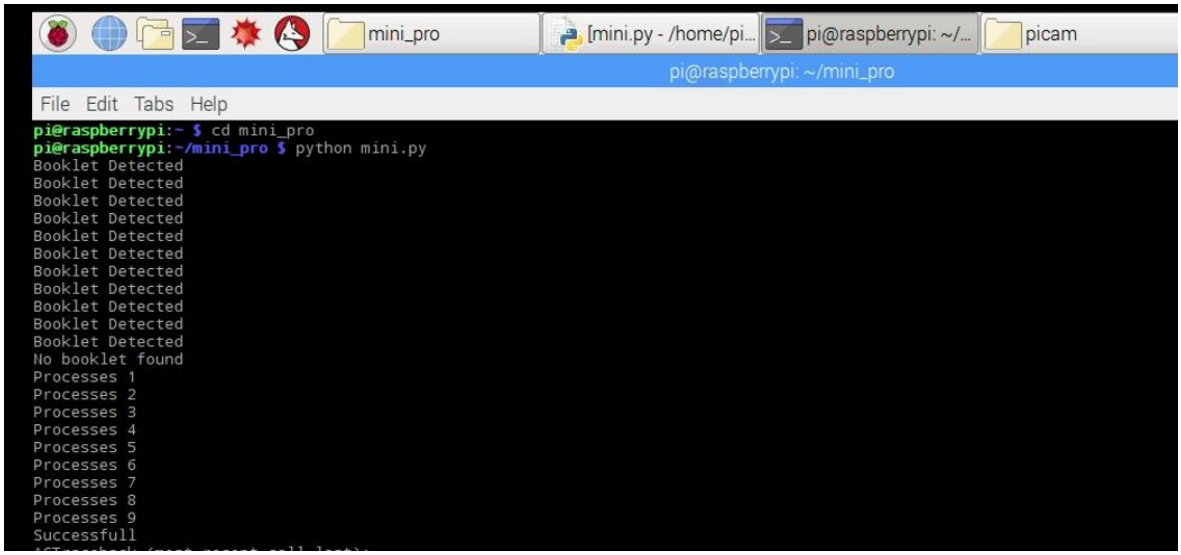


Figure 6.2: Output of the process

6.2 Output of image Processing

Captured image using picamera as shown in Figure 6.3 is the one which is before image processing.

Figure 6.3: Captured image before image processing

Image after image Processing using canny edge detection algorithm and pillow libraries is shown in Figure. 6.4, it shows that the required part of image is cropped and processed (enhanced).

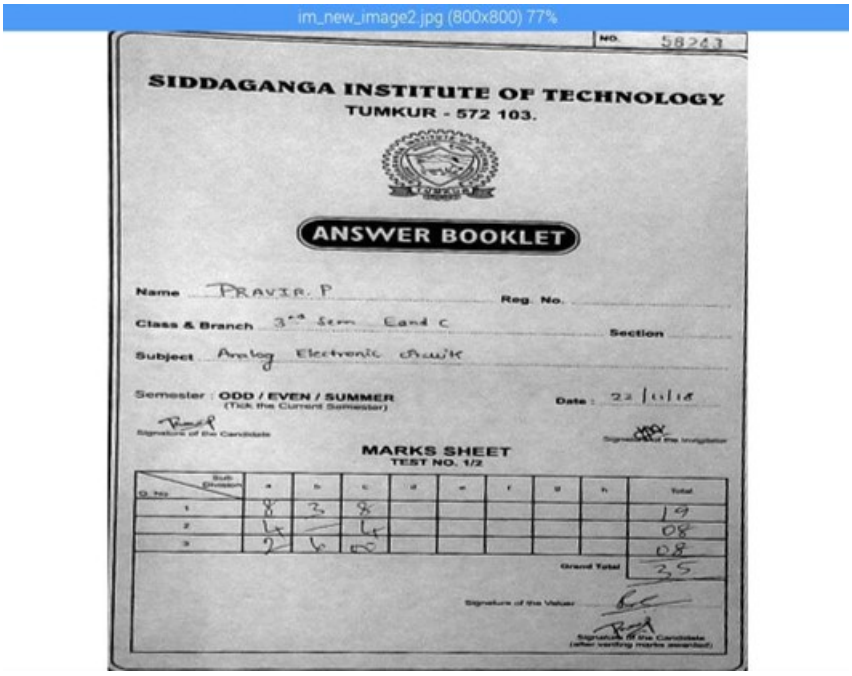


Figure 6.4: Captured image after image processing

Figure 6.5 shows how the processed images are converted to pdf format in order for storage ease.

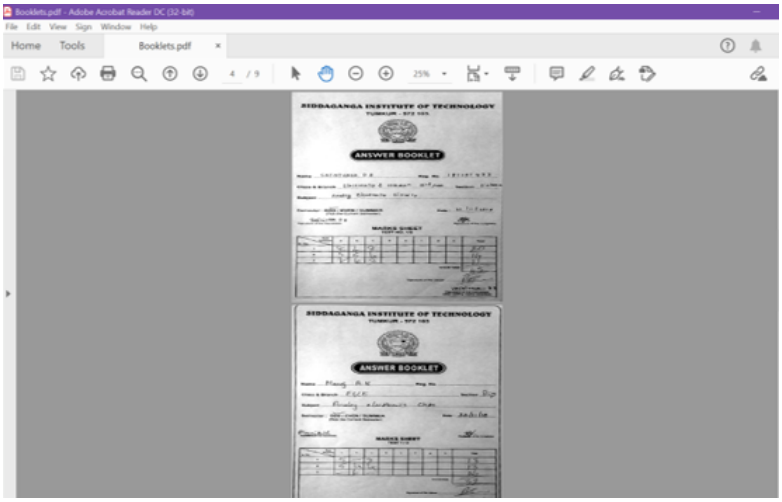


Figure 6.5: Converting all processed image to pdf

The pdf so converted is sent to mail of the teachers/students for future use and extraction as shown in Figure 6.6.

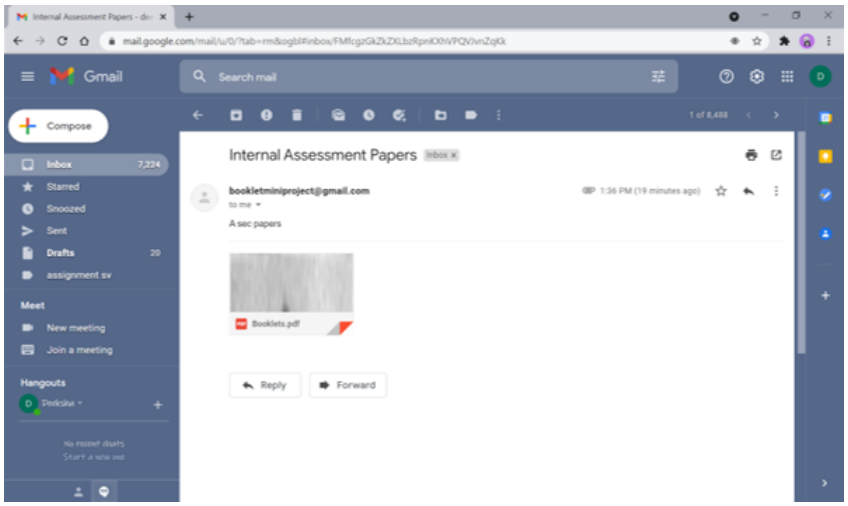


Figure 6.6: Sending mail

Chapter 7

Conclusion

Booklet lifting machine is thus able to:

1. Scan the front sheet of the internal papers.
2. Automatically slide out the booklets with less human effort.
3. Save the processed images in jpg and pdf form.
4. Send the pdf to the mail ids.

7.1 Scope for future work

The future scope of the project is to have a completely automatic booklet lifting and scanning machine which is able to extract the characters and digits of the front sheet of booklet by using machine learning algorithms and image processing and store in the database in the form of excel sheets.

Bibliography

[1] S. Nawshin, S. Ahsin, A. S. M. M. Jameel and S. Islam, "Cost Efficient Bangla Book Reader for the Visually Impaired," 2019 IEEE International WIE Conference on Electrical and Computer Engineering (WIECON-ECE), pp. 1-4, 2019.

[2] Moh. Aquib Ansari, Diksha Kurchaniya and Manish Dixit "A comprehensive analysis of image edge detection technique", *International Journal of Multimedia and Ubiquitous Engineering*, Vol.12, pp.1-12, 2017.

[3] Junseok Lee, Wonseok Jeon, Youngsu Cha and Hyunseok Yang, "Automatic page-turning mechanism with near-field electroadhesive force for linearly correctable imaging",*2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Vancouver, BC, Canada, pp. 279-285, 2017.

[4] Priyanka Bhanudas Deshmukh, "Book Flipping and Scanning Machine Review", *International Journal of Latest Trends in Engineering and Technology (IJLTET)* Vol.7, ISSN: 2278-621X, pp.234-236, September 2016.

[5] S. Ghogare, C. Mahajan and P. Mulay, "Automation related to professor evaluation", *2015 International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT)*, Davangere, India, pp. 579-582, 2015.

[6] L. Yuan and X. Xu, "Adaptive Image Edge Detection Algorithm Based on Canny Operator," 2015 4th International Conference on Advanced Information Technology and Sensor Application (AITS), 2015, pp. 28-31, doi: 10.1109/AITS.2015.14.

[7] Gabor Takacs, "Lifting Mechanism", Electrical Submersible Pumps Manual, Gulf Professional Publishing, *ScienceDirect*, ISBN: 9781856175579, accessed on 22nd April 2009, https://www.sciencedirect.com/.

[8] R. Sureswaran, H. A. Bazar, O. Abouabdalla, A. M. Manasrah and H. El-Taj, "Active e-mail system SMTP protocol monitoring algorithm," 2009 2nd IEEE International Conference on Broadband Network Multimedia Technology, 2009, pp. 257-260, doi: 10.1109/ICBNMT.2009.5348490.

Appendices

Appendix A

Data Sheet of mg995 servo motor

31150-MP

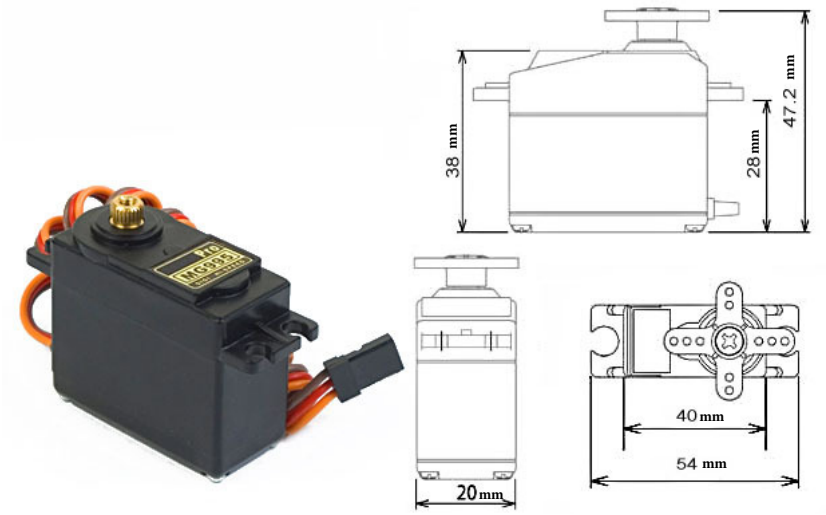
MG995 High Speed Servo Actuator

The unit comes complete with color coded 30cm wire leads with a 3 X 1 pin 0.1" Pitch type female header connector that matches most receivers, including Futaba, JR, GWS, Cirrus, Blue Bird, Blue Arrow, Corona, Berg, Spektrum and Hitec.

This high-speed servo actuator is not code dependant; You can use any servo code, hardware or library to control them. The MG995 Actuator includes arms and hardware to get started.

Specifications

- Weight: 55 g
- Dimension: 40.7 x 19.7 x 42.9 mm approx.
- Stall torque: 8.5 kgf·cm (4.8 V), 10 kgf·cm (6 V)
- Rotation Angle: 120deg. (+- 60 from center)
- Operating speed: 0.2 s/60º (4.8 V), 0.16 s/60º (6 V)
- Operating voltage: 4.8 V to 7.2 V
- Dead band width: 5 µs
- Stable and shock proof double ball bearing design
- Metal Gears for longer life
- Temperature range: 0 ºC – 55 ºC



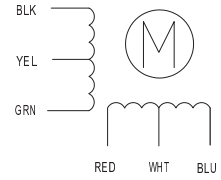
Appendix B

Data Sheet of Stepper Motor

HIGH TORQUE HYBRID STEPPING MOTOR SPECIFICATIONS

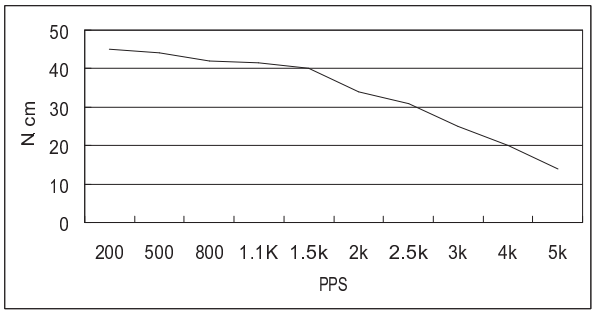
General specifications		Electrical specifications	
Step Angle (°)	1.8	Rated Voltage (V)	4
Temperature Rise (°C)	80 Max (rated current.2 phase on)	Rated Current (A)	1.2
Ambient temperature (°C)	-20～+50	Resistance Per Phase (±10%Ω)	3.3 (25°C)
Number of Phase	2	Inductance Per Phase (±20%mH)	2.8
Insulation Resistance	100MΩ, Min (500VDC)	Holding Torque (Kg.cm)	3.17
Insulation Class	Class B	Detent Torque (g.cm)	200
Max.radial force (N)	28 (20mm from the flange)	Rotor Inertia (g. cm^2)	68
Max.axial force (N)	10	Weight (Kg)	0.365

● Wiring Diagram:

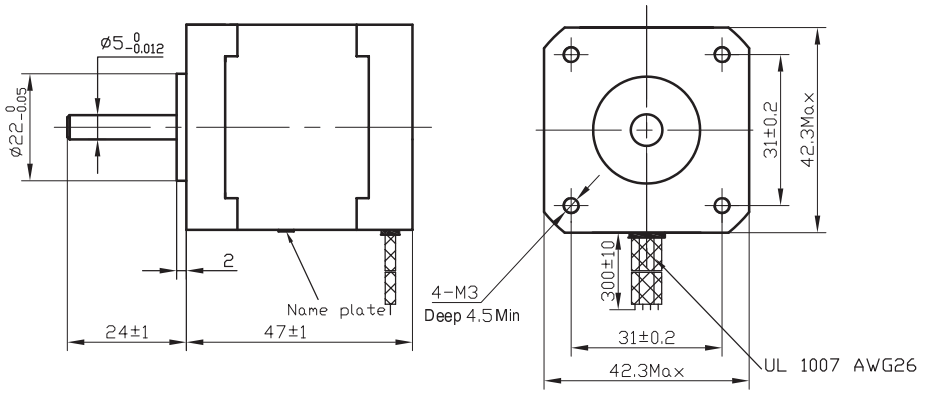


● Pull out torque curve:

VOLTAGE: 24VDC, CONSTANT CURRENT: 1.2A, HALF STEP



● Dimensions:
(unit=mm)



REV	REVISIONS	DESCRIPTION	BY	DATE
DRAW	任飞飞 2010.06.29			
CHECK				
APPROVE				

SY42STH47-1206A

TECHNICAL CONDITIONS

CHANGZHOU SONGYANG MACHINERY & ELECTRONICS NEW TECHNIC INSTITUTE

060047000