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Sophisticated and modernized library running system with OCR algorithm using IoT

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ABSTRACT

An internet of things (IoT) is an exclusive method, were its impact on the enactments of human life is very trendy. This research on library control system operates on the basis of IoT and optical character recognition (OCR) algorithm rules and its training. A closed-circuit television (CCTV) watched mechanism is created to control the book issuing and returning phenomenon via tag studying system in the library. In this proposed work text file is converted into an audio file. This audio file is being played and the contents of the book can be heard via the headset. This unique function of the OCR helps blind people. Now a days OCR widely focused in machine processes such as machine transformation, text to speech extraction and text data mining. It utilized in various area of research in artificial intelligence, computer vision and pattern recognition. Using OCR to scan the damaged book in the library converted into pdf format the book gets new life and sharing the contents to multiple readers. In this paper aims to implement IoT based library management system to maintaining books in digital format.

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1. INTRODUCTION

Traditionally library system is maintained by manually issuing books to the students, maintaining the books is a time-consuming process. In this proposed methodology introduces effective and time saving process for asset tracking and administration system for library using active radio frequency identification (RFID) technology. RFID delivers the best effective solutions for the identification of assets. In existing methodology, the library management is manual process is required and the students were entering into the library spending more time to search books in every single rack and finally get the book. This system is more ineffective, and they spent more time for searching books. Sometimes the students are unaware whether the books are existing or not. To overcome this issue to implement the proposed system to provides the automatic solution. In the library every book is inserted with RFID tag and RFID readers [1]-[6]. Manually managing library systems are vulnerable human error and slow process it difficult to store massive amounts of data or records efficiently, the library staff spends maximum of time on mechanical, clerical tasks rather than liaising with library visitors. Issuing a book is a slow process also books are more theft prone.

Combining the RFID with text recognition software to offers effective methods to maintaining the library system. The proposed system is could be helpful to overcoming these challenges.

Optical character recognition (OCR) is a mechanism for converting the scanned documents or printed texts, handwritten data into computer recognizable universal character encoding (UNICODE) format or machine-readable text over an optical mechanism. It captures the text and reading capabilities of a human eye. It widely used in data entry for digitizing the documents like passport, bills, bank reports, mail, static data, and printed data. By using this technique, the documents are digitally modified, stored compactly, searching process is quick and fast. OCR is used in machine translation processes such as text-to-speech recognition, key data, text mining and cognitive computing. In recent days most of the academics focus their research in artificial intelligence, pattern recognition, and computer vision.

2. EXISTING SYSTEM

In the existing system, bar code techniques or RFID is used. Each book in a library provided with bar code. Using bar code reader, the librarian read the bar code. But the real time problem with this technique is once the book aging has been increased the scanning defect with the bar code would be the biggest challenge. This problem has been cleared in the proposed system using the new scanning concept, added with this many conversions technique has been implemented in the new technique.

Human interference is mandatory for book issuing, maintaining the return books records and update in library database. At the time of manufacture the bar code needs to be programmed and the code is computed only once and the RFID module used is not internet of things (IoT) based so ultimately the tracking of a book is impossible as in the Figure 1. The disadvantages countered by the existing system comprise of maximum manual operation, time delay, chance of material mismanagement, less efficiency [7]-[11].

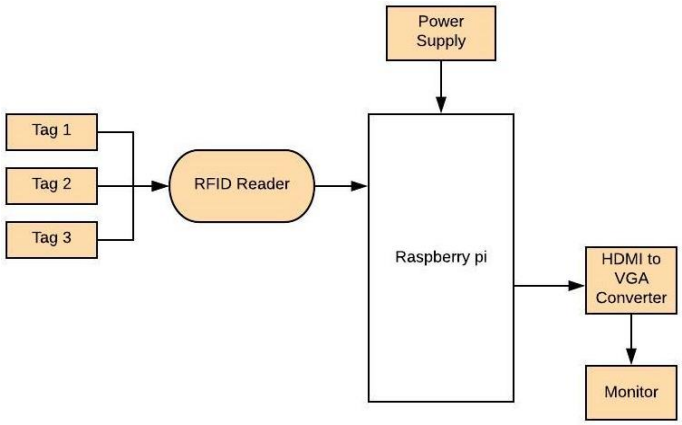

Figure 1. Existing topology

3. PROPOSED SYSTEM

The proposed system is basically an improvised version of the existing system containing the implementation of IoT in it. IoT creates a tracking system for the books by telling whether the book is present in the library or is it issued by a certain person. The automatic region of interest (RoI) detection and text localization algorithms ensure effectiveness and robustness of the system shown in Figure 2.

OCR or optical character reader is used to process the text present on the book pages by recognizing the words which are written in English language format. The work of an OCR is to localize the written English text contains in the image. OCR facilitates the implementation towards the complex background where the text is present. The working of an OCR can be explained in two step process localization of the written English text present in the certain image. Conversion and processing of the individual characters present in the text and displaying it on the laptop screen. As English is the language used in generally most of the books so the OCR implementation and working completely resides on alphanumeric which are A-Z alphabets, numerical values from 0-9.

3.1. OCR

In conventional optical character recognition systems are frequently used for delivers textual data or documents into electronic documents but it processed with only limited number of font type and page

formats. The next generation software can also make use of artificial intelligence to use advanced methods of intelligent character recognition (ICR), like the ability to identify language or style of handwriting. OCR software vary in their techniques and analyze shown in Figure 3, one character, word, or block of text at a time to identify characters using one of the following two algorithms i) Pattern recognition ii) Feature detection. OCR software are developed by working with various types of text with different fonts and formats it can understand the shape or pattern of characters, easily identify the correct image. By using de-skewing and de-noising algorithms to easily transform the direction and position of the image, reduce the lot of noise it increases the image quality. Various stages include in designing of an OCR are, i) Image pre-processing, ii) Text recognition, iii) Character segmentation, and iv) Image post-processing [12]-[17].

i) Image pre-processing: By using Binarization process take the actual image is transformed into gray-scale image next it converted into binary image. Later the image perfectly aligned using De-skew process.
ii) Text extraction: To extract each character then using Matrix matching technique to comparing image with each pixel then perform "pattern matching", "pattern recognition", or "image correlation".
iii) Character segmentation: Compare the extracted character with the matched template.
iv) Image post processing: The mismatched characters from final step's remaining text are checked with the additional templates. Finally, it transformed the image into text format.

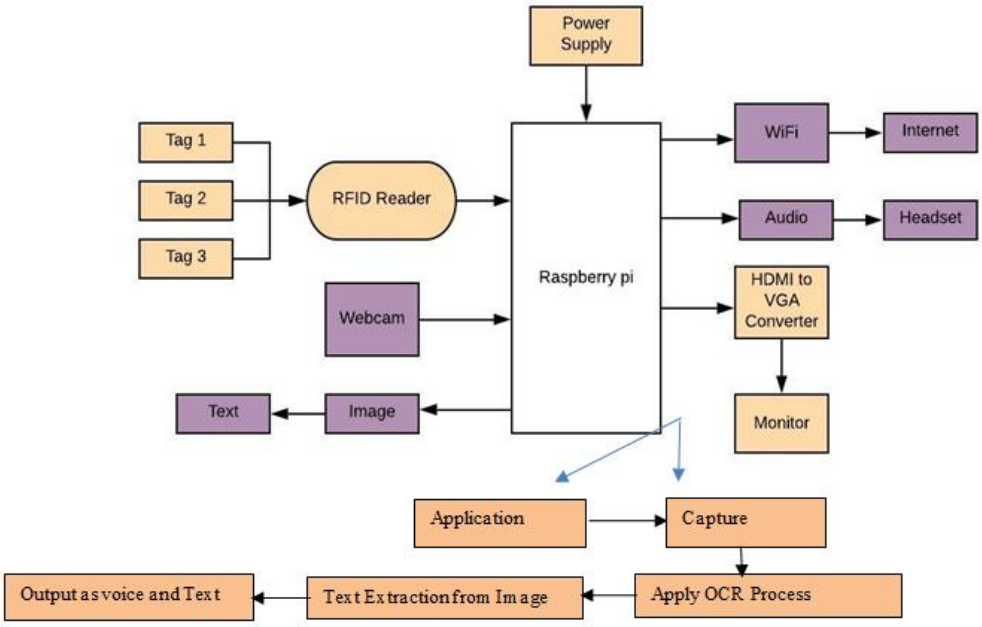

Figure 2. Proposed block diagram system

Figure 3. Optical character recognition process

3.2. Benefits of transforming physical data into digital format

1) High security: Keeping the physical data is difficult compared with electronic documents it can easily tracked, access permissions, password protection to restrict the documents.
2) Space limit: It hard to maintaining the physical documents it occupies more physical space. Digital documents are minimizing the usage for paper it can help to save more space.
3) Data recovery: It prevents documents from unexpected manual mistake or natural catastrophe, the hazard of losing physical documents is better to keep in digitizing them.
4) Simplify access: Compare to physical data the digitizing documents can easily access, search process saves a lot of time.
5) Cost efficiency: Digital documents will reduce the cost compared to physical data which consumes massive cost of paper, printer, and ink.
6) Eco friendly: Digitalizing documents saves a lot of resources like paper, ink (chemicals).
7) Data sharing: Data sharing is easy and quickly in digitized format but not easy in case of physical data.

3.3. Power circuit supply

1) Transformer

The transformer comes under the mostly used category of instruments used in electrical engineering. A transformer transforms and transfers electric power from one electrical circuit to another. Its work is to manipulate the voltage in correspondence to the current levels. The transformer used here is a step-down transformer which converts an input voltage of 230 V to 12 V. this 12 V output from the transformer is carried forward to other parts of the power supply circuit shown in Figure 4.

2) Rectifier

The rectifier used here is a bridge rectifier. Its work is to improve the obtained dc level sinusoidal signal by 100 folds. It consists of two sets diodes each set comprising of 2 diodes. In the positive cycle of operation, the diodes D2 and D3 are in ON state and the diode set D2 and D4 are in OFF state at a time period of T=0 to T/2. And similarly, in the negative cycle the diodes D1 and D4 are in the ON state which produces a constant polarity [18]-[22].

3) Filter

Filters are used here to suppress the ripple density. A capacitive filter is used here where the capacitor is positioned exactly at the termination of the rectifier bridge output via which a dc output is obtained. The waveform obtained after filtering has a ripple density tending towards 0.

4) Regulators

The output voltage obtained from the capacitive filter requires more filtering and regulation and hence a voltage regulator is used. The work of a voltage regulator is to convert the 12 V supply to a 5 V supply and keep it constant irrespective of the changes in the load and temperature.

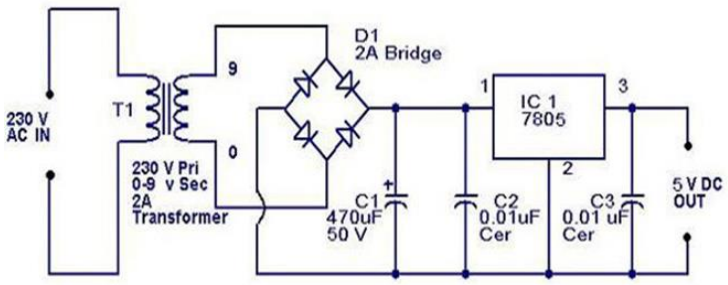

Figure 4. Power circuit supply

4. HARDWARE DESCRIPTION

The Raspberry Pi is the centralised main working system of the management system. It has a 4-way universal serial bus (USH) hub which helps the pi to boost up and display the messages on the screen. It consists of a broad com BCM2837 64bit ARMv7 quad core processor powered single board computer running at 1.2 GHz, 1GB RAM and a 40-pin extended general purpose input/output (GPIO). A 125 KHz operating EM-18 RFID reader is a less cost idea for our RFID based application, this reader module added up with an on-chip antenna and it can be powered up with a 5 V direct current (DC) power supply. After the

module has been powered-up it has been connected to the transmit pin and the receive pin of our microcontroller shown in Figure 5.

Figure 6 represents the webcam comes fitted with an auto focus wide-angle lens that has smaller focal length to capture more of your subjects. The webcam is used to access the text present on the book which is later compiled by the Raspberry Pi to produce an audio output. Figures 7 and 8, represents the ultrasonic and proximity sensor which are the two most important sensor which has been needed for collecting the information and sending the same to RFID, it measures the distance to an object from the book using the help of ultrasonic sound waves. And it uses a transducer, to send and receive ultrasonic pulses that relay back information about an object's proximity.

Figure 5. RFID reader modules

Figure 6. Camera/webcam

Figure 7. Ultrasonic sensor

Figure 8. Proximity sensor

5. CIRCUIT OPERATIONS

As the name internet of things (IoT), the library management system designed by us operates on its ideology. The working of the library management system can be divided in two halves. The first half indulges of the hardware parts which comprise of Raspberry Pi, RFID module, power supply circuit, ultrasonic sensor, headphones, camera, electrical tags, and the splitter circuit. Whereas the software part mostly resides in the Raspberry Pi where the whole projects operate on Raspbian software. The usage of IoT inculcates within the usage of Wi-Fi which provides the internet, the webcam/camera and the headsets or headphones. In the power supply circuit, the transformer converts the generate supply of 230 V into 12 V AC. This ac voltage is then converted to a dc level using the rectifier and further this supply passes through the low pass filter which is basically a capacitive filter which basically remove the riles and the regulator produces a steady output voltage 5 V.

This 5 V supply is carried forward to the splitter circuit. The splitter circuit splits the supply to the Raspberry Pi, ultrasonic sensor, and the RFID reader module. The Raspberry Pi has slot connectors namely universal serial bus (USB0, USB1, USB2 and USB3). The software compilation of the Raspberry Pi is stored in a micro-SD card which occupies a space of 14 GB. The micro-SD card is connected to the USB0 port of the Raspberry Pi, and the USB1 port is occupied by the keyboard (if an assembled computer is used instead of a laptop). The USB 2 port is being occupied by the camera/webcam. The Raspberry Pi has two separate ports for the connections of headphones and high-definition multimedia interface (HDMI) to video graphics array (VGA) converter [23]-[25].

We are using three books for the working of this library management system. Each book is associated with an electrical tag. These tags are scanned by the RFID reader. The general-purpose input/output (GPIO) of the Raspberry Pi is associate with the pin numbers 11 and 13, 11 being the output pin and 13 being the input pin. When the tags are identified by the RFID reader the corresponding data is sent to the Raspberry Pi and is shown on the screen when the Raspberry Pi connected to the laptop/computer. The tags are dignified in the name of variables according to the Raspbian software namely i, j and k representing tag1, tag2 and tag3 respectively. As the first book is recognized the software compiles the data and creates a

'text.txt' file representing book1 of the library. If the book 1 is being issued form the library the status of the book1 is given as "book take from the library" at the webpage this obliges a certain process where the 'text.txt' file is converted into a pdf file and then it is further displayed on the webpage, and if the book 1 is given back at the library then the webpage status changes to "book is returned to the library" [26]-[29].

6. TESSERACT OCR

Tesseract is one of the best open-source OCR engines, it supported for different operating system such as Linux, Windows, and Mac OS. The newest version (v4) of OCR engine uses in the field of AI for Text data mining and text recognition. It worked based on neural networks logic the same mechanism applied in long short-term memory (LSTM) algorithm is used in Tesseract. It presently supports the text recognition of many manuscripts of more than 100 languages [30], [31]. First, we need to install the Tesseract library then only we use the software. Tesseract have pre-compiled libraries for windows so it easy to use and it is a command line tool to execute our commands. Pytesseract is a convenient tool for python it will recognize and "read" the text embedded in images, it is a wrapper class for Tesseract-OCR engine. It extracts the text from image then it stored in a separate text file shown in Figure 9 [32]-[36].

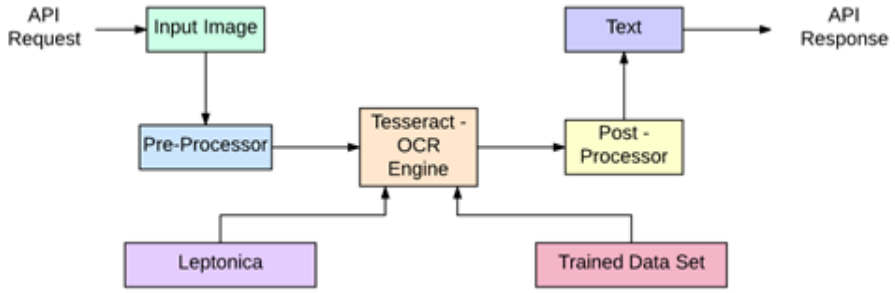

Figure 9. OCR process flow to build API with Tesseract

An image is embedded with text is given as input to the Tesseract command. Tesseract executes the command it takes two parameters. First parameter is actual file name of the image it comprises textual data and the next parameter is the output text file it stored the extracted text data. The extension of the output file is .txt it automatically taken from Tesseract, so the user no need to mention the file extension .txt file is the output file name as a second parameter into the Tesseract. Once the processing is completed, the content of the image is transformed into the output file .txt file. If the input image is should be color image either grayscale image, Tesseract provides 100% accuracy for grayscale image. In case of convoluted images Tesseract processing the images and finally delivers better accuracy results. Convert PDF file into text file.

Steps to be followed for pdf to text file:

a) Import the PDF2image and pytesseract modules.
b) Open the PDF file.
c) PdfFileReader() to read the PDF and give the correct path of the PDF as the parameter.
d) Save() method is used to saving the content with extension.
e) Extract the text from the image using image_counter variable.
f) Set the limit of output file.
g) Using pytesseract.image_to_string() to extract the file content.
h) Using replace() methods to convert pdf file into text file.

Coding

```
# Import libraries
from PIL import Image
import pytesseract
import sys
from pdf2image import convert_path
import os
input_file = "sample.pdf"
page = convert_path(input_file, 600)
image_cntr = 1
file_name = "page_"+str(image_cntr)+".jpg"
page.save(file_name, 'JPEG')
image_cntr = image_cntr + 1
file_limit = image_cntr-1
```

```
out_file = "output_text.txt"
f = open(out_file, "i")
for a in range(1, file_limit + 1):
file_name = "page_"+str(a)+".jpg"
text_file = str(((pytesseract.image_to_string(Image.open(file_name)))))
text_file= text_file.replace('-\n', '')
f.write(text_file)
f.close()
```

6.1. Convert PDF file into audio file using python

Figure 10 represents converting a textual PDF file into audio file it needs to include these packages pyttsx3, PyPDF2.pyttstx3 is a Python library for Text to Speech it supports many functions and it helps to machine communicate with us. PyPDF2 for convert to the text from the PDF. It contains in python library the purpose of the PDF toolkit is to extracting data from the document, dividing the documents page by page, integrate documents page by page. Both these modules need to be installed pip install pyttsx3, pip install PyPDF2. Steps to be followed for pdf to audio file:

a) Import the PyPDF2 and pyttx3 modules.
b) Open the PDF file.
c) PdfFileReader() to read the PDF and give the correct path of the PDF as the parameter
d) getPage() method to select the page to be read.
e) Extract the text from the page using extractText().
f) Instantiate an object for pyttx3.
g) Using say() and runwait() methods to speak out the text content.

Placement preparation guide:

This guide will cover everything related to capture your dream job, the following are the development made by us related to build your confidence, it consist of

- Resume building
- Application dependence
- Details of interview
- Practical tracks
- Group discussion
- Mock interview
- FAQ solving
- Additional support related to technical, language etc.

Types of interviews are;

- Mass recruiters
- Tech grants
- Others \ start ups
- Company contacts
- Direct interaction with recruiters
-

Hope we are serve here to reach the formula called

Students = employers

```
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•  Tech grants
•  Others \ start ups
•  Company contacts
•  Direct interaction with recruiters

Hope we are serve here to reach the formula called
        Students = employers
```

Figure 10. Converting pdf file into text file

Coding

```
# importing the modules
import PyPDF2
import pyttsx3
class reading:
book= open ('C:\\Study_Material.pdf', 'rb')
pdfReader = PyPDF2.PdfFileReader(book)
paged = pdfReader.numPages
print(paged)
speak = pyttsx3.init()
from_page=pdfReader(15)
text = from_page.extractText()
speak.say(text)
speak.runAndWait()
```

The working of the OCR is initiated after the first step, which is the scanning of the tags present on the books. Then via the ultrasonic sensor the distance between the book and the camera is determined. This helps the camera to access the text written in the book, the analyzed text is processed by the Raspberry Pi via the Raspbian software where later the text file is converted into an audio file. This audio file is being played and the contents of the book can be heard via the headset. This unique function of the OCR helps blind people to read a book by actually hearing it shown in Figure 11.

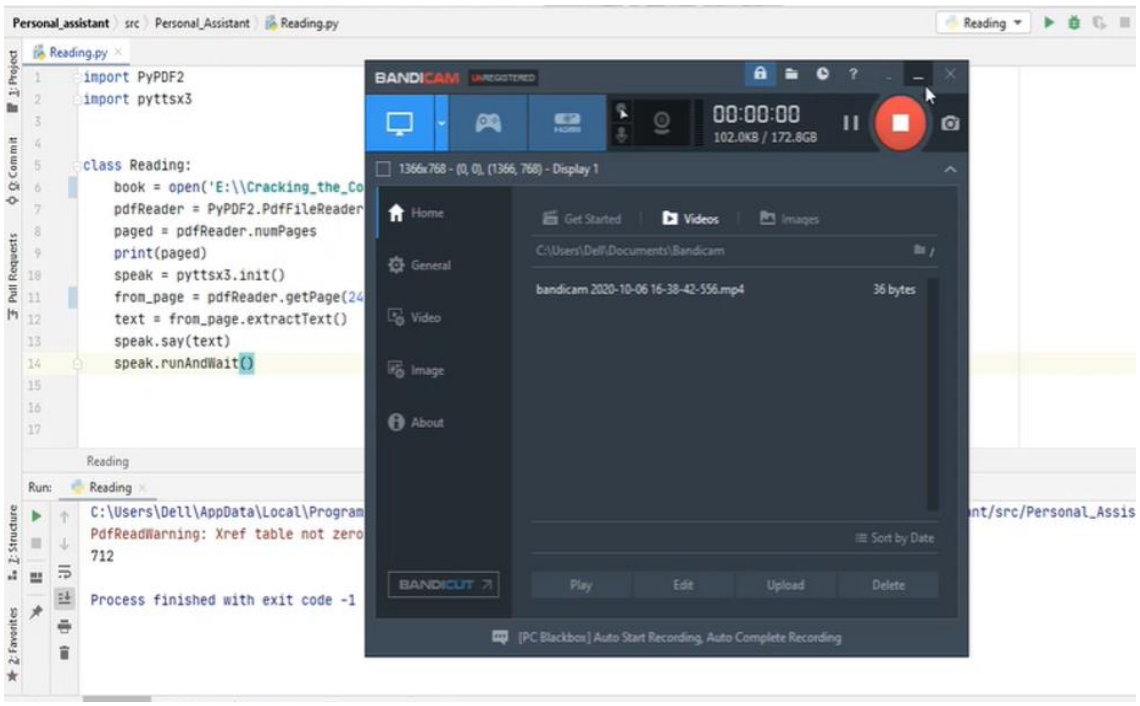

Figure 11. Converting pdf file into audio file

7. CONCLUSION

Here updated version of library management system has been analyzed and compared with the regulatory of the existing one, at the whole, outcome of this experiment shows that the proposed one is better compared to the earlier technology with more advancement in the field of library management that pay the way to develop the advanced library management system which inculcates the OCR implementation very wisely. The book issuing and returning system created is highly efficient and secured added with two important concept like conversion of pdf file into highly visible text file and it also has been converter to audio file where it has been widely used for blind people in the society which improves there eager in the library usage the above technique has been verified using coding and outputs.

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