# AUTOMATIC PAPER CRAWLING POCKET-SIZED CHARGEABLE PRINTER WITH WIRELESS CONNECTIVITY

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***Abstract:*** Traditional available printers in the market are very large and bulky also they are wired up to the computer, making them inconvenient to carry from one place to another and hence reduce our productivity. To solve this issue, we propose a mini, smart and wireless printer that is portable and has many features. The proposed printer is small enough to fit into a usual pocket and moves itself and prints letters wirelessly on any sizeof paper, which means these miniature printers are ideal for printing directly from your laptop, smartphone or tablet. This kind of printer could be just as big as a cup, which is very convenient to carry wherever you go and print efficiently.

***Index Terms*** **- Pocket, Smart, Wireless, Printers, Mini, Efficiency**

## I. INTRODUCTION

Printers play a very important role in daily life. They assist business staff in printing office papers and contracts, as well as student graduation theses and reading resources. Given numerous new mobiletechnologies, products are becoming more flexible and portable, even printers are evolving. And henceprinters are becoming smaller and smaller, and more convenient to carry. In today's day to day life, there is no such product like this kind of mini smart printer. There are two kinds of mini printers in the market. The first is the ink-jet printer. Those are used to print receipts and have limited functions. The second is a kind of dye sublimation printer. However, these kinds of printers have high requirements of paper. Also, they are expensive to maintain. Both printers have a paper size limitation,which is a significant change from our mini printer. Our proposed mini printer can operate on any size of paper since the mobile way is apparently used to print words while writing. In addition, Wi-Fi is used to access the printer system. When we need to print any document, we just need to send a file on our mobile phone or computer to the printer system to print out. Method used by our pocket printer is different from traditional methods. As soon as the pocket printer starts printing, the printer itself moves in a straight line on the paper, and the printing head fixed within the printer prints characters. And these two functions - moving and printing work are done parallelly.

The rest of the paper is organized as follows: In section II the drawbacks of traditional printers are highlighted and how the proposed printers overcome is given in the form of problem definition. The components required for the mini printer are listed and explained in section III. The hardware and software design of the compact proposed printer is given in section 4 and 5 respectively. Results and its discussion are carried out in section 6 and finally we conclude in section 7.

## II. PROBLEM DEFINITION

Printing in private contexts becomes more and more a second choice. But sometimes you necessarily have to print out your documents mostlyon a quiet space consuming printer. For all of those who don't want a big printer, one who just prints every once in a while, or people who have to print on the go, there is a new solution. The aim is to design an "Automatic Paper Crawling Pocket-sized Chargeable Printer with Wireless Connectivity" in acomprehensible manner in order to help the users just place the printer properly at the top of the pageand guarantee an accurate outcome.

### 2.1 Drawback of traditional printers

The traditional printer has some disadvantages. As we know, the traditional printers are big, so it is impossible to carry around. We have to go somewhere with a printer when we need to print something, which is very inconvenient and inefficient. For the other hand, the size of paper for traditional printers is fixed, that is to say, the kinds of paper size we can use are limited. Also, they can't print on heat transfer papers and are not able to produce high-quality photographic prints. Finally, the traditional printer is more expensive and has a more complex structure, which results in a higher maintenance cost. To solve these problems, a mini smart printer is developed. Our mini smart printer is a new kind of printer that is easily carried, not limited by the size of paper and cheaper than the traditional printer. The paper is based on a research paper by Kang P and *et.al.* [1].

## III. PROPOSED PRINTER

The compact and portable printer which we propose to build has the same quality as that of the traditional printers along with added features. In this section, we explain the components that are required to build such a printer. In the next section the hardware and software design are given in detail.

### 3.1 Components

Table 1 gives the list of components required for the printer.

| Sr. no | Component name | Quantity |
|---|---|---|
| 1 | Arduino Mega 2560 | 1 |
| 2 | Raspberry pi (version 2014) | 1 |
| 3 | USB wireless network adapter (BL LW05 5R2) | 1 |
| 4 | HP-C6602A ink-jet dot matrix printing head | 1 |
| 5 | Omni wheels | 4 |
| 6 | 20 V boost converter (MC34063A) | 1 |
| 7 | ULN2803AN Darlington transistor array | 2 |
| 8 | CD4067 16 channel analog multiplexer/Demultiplexer | 1 |
| 9 | 1N5819 Schottky diode | 1 |
| 10 | Inductor 180uH | 1 |
| 11 | 180-ohm resistor | 1 |
| 12 | 0.22-ohm resistor | 1 |
| 13 | 33k-ohm resistor | 1 |
| 14 | 2k-ohm resistor | 1 |
| 15 | Capacitor 100uF | 1 |
| 16 | Capacitor 1.5nF | 1 |
| 17 | Capacitor 330nF | 1 |
| 18 | Led | 2 |
| 19 | Lego platform | 1 |

## IV. HARDWARE SYSTEM DESIGN

The mini pocket printer should work in a mobile way, so for achieving this we have to control the printing head and the movement of the printer. The mini printer has Wi-Fi capabilities so it can connect with a mobile, computer and laptop and communicate with it wirelessly through Wi-Fi. The inkjet printing head is the main component here soit should be chosen carefully.

### 4.1 Block diagram

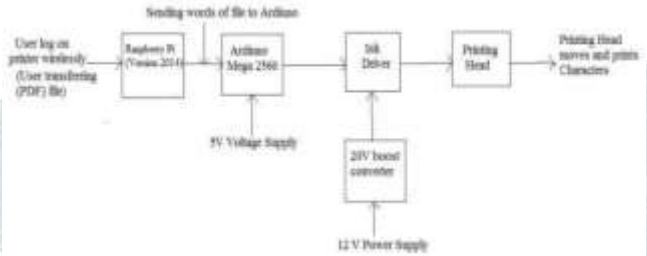


Fig. 1 Block diagram of the printer

Figure 1. shows the basic block diagram for the mini printer. To print any file with a mini printer first a user has to log on to the printer wirelessly. After logging onto the printer, the user has to select the pdf file to print and transfer it to Raspberry pi via USB wireless network adapter. The pdf file is sent to the Raspberry pi. The Raspberry pi reads the pdf file and converts it to a plain text file usinga linux command “pdftotext” and it sends the characters of the text file to Arduino Mega 2560. As Arduino Mega 2560 receives the characters of text files from Raspberry pi, it will generate the control signals. These control signals will be given to the Ink Driver. The Arduino Mega 2560 is provided with a 5 V power supply. The Ink driver receives the control signals from Arduino Mega 2560 and then it transmits these control signals to the printing head and it also transmits the power from a 20 V boost converter to the printing head. As the printing head gets the signals from the Ink driver it moves and prints the characters parallely on the paper.

### 4.2 Circuit Diagram

The whole circuit is divided into parts and is tested/simulated in Proteus 8 Professional software.

**4.2.1 Arduino Mega 2560:** The Arduino Mega 2560 is the control component. It consists of two parts: Arduino board and a Raspberry Pi. The Arduino board generates the control signals and it controls the printing head to print the characters and it also controls the movement of the printer. The RaspberryPi is used to send the characters of the text file to the Arduino Mega 2560 which the user wants to print. The Arduino Mega 2560 circuit is shown in the Fig 2.

**4.2.2 Power Supply:** The power supply provides the power to the Arduino board and printing head. The working power of the Arduino Mega 2560 is 5 V and the printing head is 20 V hence we need different power supplies for both.

**4.2.3 20 V boost converter:** The printing head works on 20 V power supply. The 20 V boost converter is used to provide stable power at 20 V for the printing head. It is made as a separate component toprotect the circuit from any damage. The 20 V boost converter circuit is shown in the Fig 3.

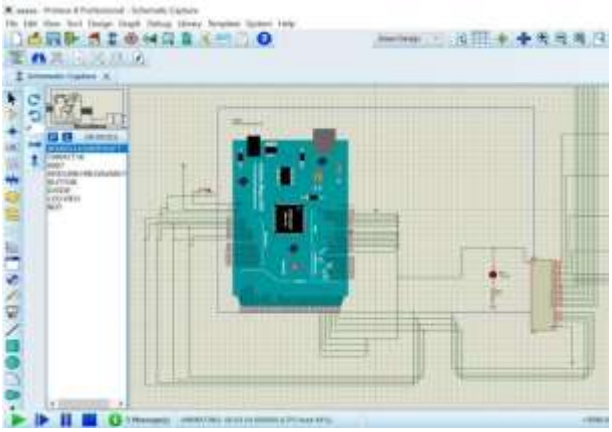

Fig.2 Arduino Mega 2560 circuit

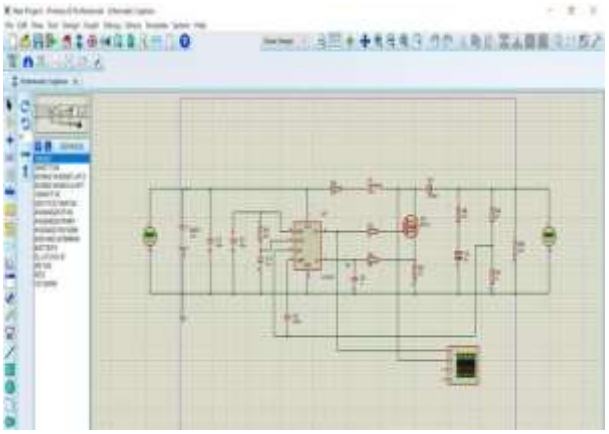

Fig.3 20 V boost converter circuit

**4.2.4 Ink Driver:** Ink driver is used to transmit the control signals from the Arduino Mega 2560 to the printing head and it also transmits the power from the 20 V boost converter to the printing head. Ink driver has 16 output ports to receive the control signals, which are corresponding to the ports on the printing head. The Ink driver circuit is shown in the Fig 4.

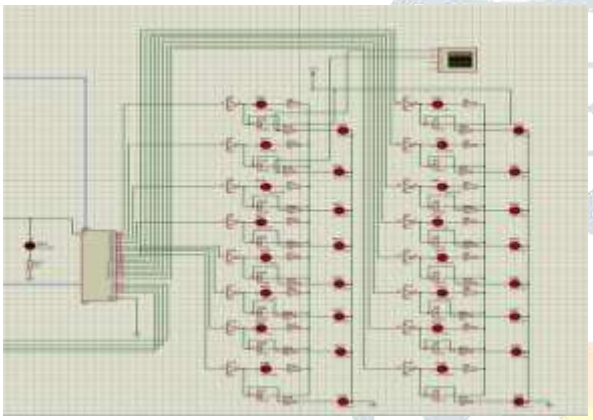

Fig. 4 Ink driver circuit

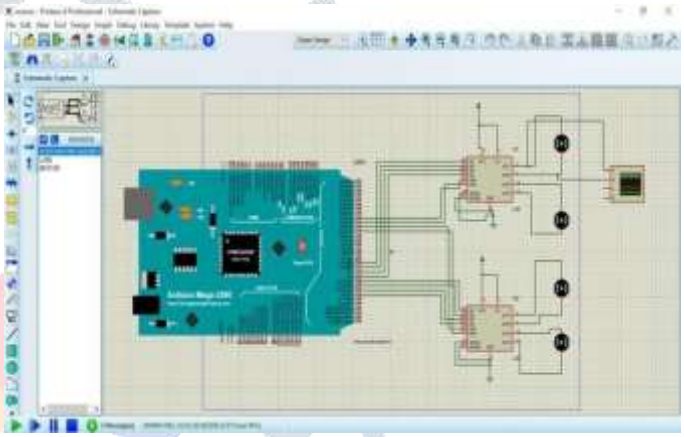

Fig.5 Printer moving circuit

**4.2.5 Printer Moving circuit:** The printer has to move in a straight line hence four motors are used to drive four wheels. Two ink drivers are used to drive four motors. A single ink driver drives two parallel wheels. The Printer moving circuit is shown in Fig 5.

### 4.3 Control component

The control component is divided into two parts: an Arduino board and a Raspberry Pi. Control signals will be generated by the Arduino board to control the printing head to print words and control the movement of the printer. Arduino Mega 2560 is chosen in this project. The Arduino Mega 2560 is a microcontroller board based on the AT mega 2560. It has 54 digital input/output pins. 16 of the output pins are used to generate control signals for the printing head. The Raspberry Pi is used to transfer the characters from the users file to Arduino Mega 2560. It is also used for wireless communication. Raspberry Pi(version 2014) is chosen in this project. It has the Compute Module packages a BCM2835 with 512 MB RAM and an eMMC ash chip into a module for use as a part of embedded systems. The Foundation provides Debian and ArchLinux ARM distributions for downloading.

### 4.4 Communication component

The mini pocket printer can communicate with a mobile, computer or laptop wirelessly. To communicate wirelessly a USB wireless network adapter (BL-LW05-5R2) is used. It supports 802.11b/g/n wireless network protocol. Its transmissionspeed is 150 Mbps. This speed is sufficient for communication between the printer and the mobile, computer or laptop. BL-LW05-5R2 uses the CCA technology to automatically avoid the channelinterference and make full use of the advantages of the channel, to ensure that the use of wireless networks will not affect the neighbors. It also supports WEP encryption, WPA/WPA2, WPA- PSK/ WPA2-PSK and other advanced encryption and security mechanisms. The communication between the mini pocket printer and the mobile phone becomes much easier through wireless networks.

### 4.5 Printing head

In this project, the inkjet printing head is chosen as the actuator. The printing head HP- C6602A is chosen in this project. It is because this kind of printing head satisfies the printing requirements, it is easier to control and cheaper than other printing heads . HP-C6602A is a dot matrix printing head. Dot matrix printing is a type of computer printing which uses a print head that moves back and forth, or in an up and down motion on the page and prints by impacting and striking an ink-soaked cloth ribbon against

the paper, much like the printingmechanism on a typewriter. However, unlike a typewriter, letters are drawn out of a dot matrix, andthus, varied fonts and arbitrary graphics can be produced. The advantage of dot matrix is that they can produce graphical images in addition to text however the text is generally of poorer quality than impact printers that use letterforms.[1]

### 4.6 Moving platform

To make a perfect product, all of these parts should be put on a moving platform including Arduino, raspberry pi, power supply, 20 V boost converter, and Ink driver. And all of these parts should be integrated to minimize our product. At present, in terms of testing and efficiency, we just use Lego to make a simple platform. And we fix our printing head under the platform and our voltage management and integrated part on the platform. With four wheels making a crisscross pattern, our printer could move in a straight line on the paper driven by the Arduino and print letters clearly. This is the main difference between our pocket printer and other printers in the shopping mall.[1]

## V. *SOFTWARE SYSTEM DESIGN*

In order to implement the function of a pocket printer; we need to design a robust software system.With this designed software system pocket printer could receive characters from the file which the user wants to print, and then it controls the printing head to spray ink and moves on the paper. The following fig.16 shows the flow diagram of pocket printer software system design. We will see thesoftware system design step by step.

### *5.1 Flow Diagram:*

Fig. 6 shows the detailed flow chart

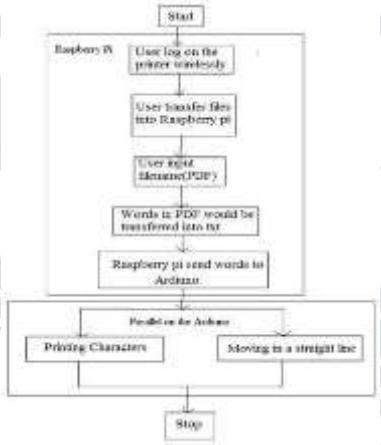


Fig.6 Flow diagram of pocket printer software system design

#### 5.1.1 Steps:

**1) A shell script needs to be implemented on the Raspberry Pi:** Shell script is like an application which users could click and run to print their files. In the meanwhile, in order to print PDF files, an important Linux command C pdftotext needs to be used when we write and implement this shell script. This command is an open-source command-line utility for converting PDF files to plain text files.

**Shell script:**

```
1 #! /bin/bash
2 echo –n “Enter your filename (PDF):”
3 # user input the file they want to print
4 read filename
5 pdftotext $filename output.txt6 python transfer.py
```

**2) Serial communication:** After that to send the converted plain texts to Ardiuno a serial communication is established between python and Arduino Mega 2560. We have used Python 3.7 version i.e Spyder to execute Python code. To establish serial communication between Ardiuno mega 2560 and Python we have installed the Pyserial module in Python to send the characters from text file to Ardiuno serially. Following is the Python Code executed in Spyder.

**Code for Serial communication in python i.e. transfer.py code:**

```
import serial import time
arduino=serial.Serial('COM3',9600)time.sleep(2)
f=open("demo.txt", "r")while 1:
line=f.readline()
if not line:break
for letter in line:
arduino.write(b 'letter')
print(letter)
time.sleep(1)
f.close()
```

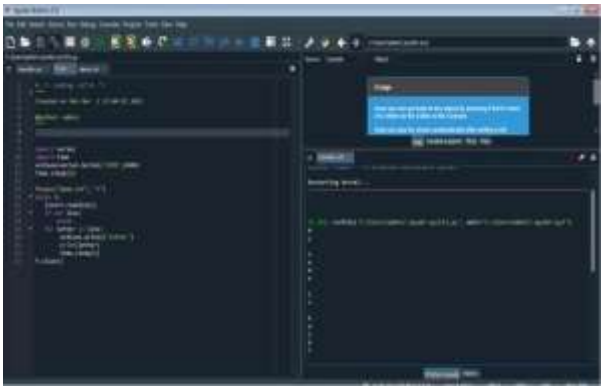

Fig.7 Serial communication code implemented on spyder

**Arduino Mega 2560 code:** Following is the code for arduino to receive the characters from python. In which we have connected led to pin number 13 which blinks accordingly when Ardiuno receives the characters. Ardiuno stores each character in its buffer.

```
void setup() {// put your setup code here, to run once:
pinMode(13,OUTPUT);
digitalWrite(13,LOW);
Serial.begin(9600); }
void loop()
{// put your main code here, to run repeatedly:
 if(Serial.available()>0)
 if(Serial.read()=='s')    {
 digitalWrite(13,HIGH);
 Serial.println("Letter is s and Led is on");delay(2000);  }}
 else{
 digitalWrite(13,LOW);}}
```

Fig.8 Arduino Mega 2560 code for receiving the characters from pythonimplemented on Arduino IDE

**3) Control printing head**: Next to control the Printing head, a library needs to be created which tends to contain various words we would use to express in our daily life. And a matrix called font is used to contain these characters whose ASCII are between 32 and 96. Each character is represented with a matrix which has ten rows and 18 columns. And in every row, thefirst two codes 0b stand for control signal, the next two codes 00 mean low voltage level, the following two codes 00 are stored and the remaining 12 codes are used to control whether the printing head will spray ink or not (1 represents spraying ink and 0 represents not). An example is shown in the following Fig. 9 which stands for the character E and F. Then Arduino Mega is initialized on pin 2 and its frequency is set to be 9600. And after that, ifthere are characters in the buffer of Arduino which means Arduino receives the words transferred from the raspberry pi, Ardiuno will judge which character it is and use the function “spray letter” to print these words. Following that, if these characters are recognized to be lowercase letters, they need to be transformed into uppercase letters, because our character library only has letteres whose ASCII are between 32 and 96. Next we need to focus on how to realize the function of “spray letter”. In these functions, it firstly uses #ASCII of letters we want to print to find its beginning row in the matrix “font”. Then it uses a loop function for ten times (each letter is represented by a matrix with ten rows) and uses the function “spray ink” to print each row of the letter. Finally, this pocket printer could print a complete letter we want to print.


Fig.9 Character E and F representing with matrices [1]

Furthermore, we should pay attention to realizing the function of "spray ink". From existing information, our printing head is an ink printing head. If we want this printing head to spray ink, pulse signals should be given to the corresponding channels of this printing head. And each letter is actually controlled by 12 channels (2 of 14 channelsare stored). Then pulse signals are given to the corresponding channels based on the digits from theright to the left of each letter's matrix row. If Arduino reads 1, then pulse is given to that channel,or it will not receive the pulse signal. One example is displaying in Fig.10. In which we just use Row 3 to demonstrate our idea.

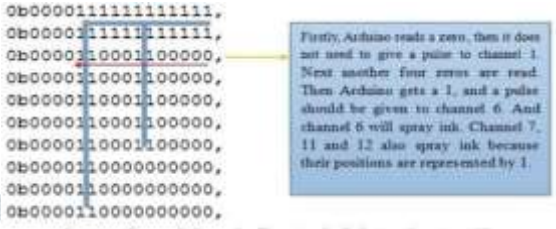


Fig.10 Ardiuno reads the matrix of letter F and calls the Function"Spray_ink"[1]

***Code for controlling:***

Fig.11 Arduino code for spray ink is implemented on the Arduino IDE

**4) Printer moving:** Next step to move the printer on paper. Unlike general Printers, they all need paper to move forward. Our printer needs itself to move in a straight line. So, the function of moving needs to be implemented in the Arduino. L298 driver IC is usedto control two parallel wheels. Hence need 2 driversIC to control four omni wheels.

**Code for moving:**

Fig.12 Arduino Code for moving is implemented on Arduino IDE

**5) Printer moving and printing in parallel:** At last, to work Printing and Moving function in parallel on the Arduino, The Arduino Task Scheduler is used to Schedule printing and moving tasks Automatically. The Ardiuno task scheduler is like a library and provides some useful functions to us to schedule different tasks on the Arduino. Firstly, Sch.init() and Sch.start() are put into the function setup(), and then Sch. dispatchTasks() is located in the function loop(). In these two steps, Sch.init(), Sch.start() and Sch.dispatchTasks() arethe functions offered by that project. And then, the implementations of function printing and moving are added at the end of codes. Finally, Sch.addTask() is called between Sch.init() and Sch.start() to add tasks into the task scheduler, like the following example in the Example code for taskschedule. With this library and these useful functions, Arduino could schedule the printing function and moving function through adjusting different parameters and use the most

appropriate parameters to make these two tasks work perfectly in parallel. And all of these things will make our printing clearer, neatly and wirelessly.

**Example code for task Schedule**

```
1  void setup(){
2  //code…
3  Sch.init();
4  //Add printing task.
5  //Starts at the 0th ms, and runs every 1 ms
6  Sch.addTask(printing, 0, 1, 1);
7  //Add moving tasks.
8  //Starts at the 1th ms, and runs every 2 ms
9   Sch.addTask(moving, 1, 2, 1);
10        Sch.start();
11        }
```

### VI. RESULTS AND DISCUSSION

The circuits are tested in the Proteus 8 Professional software. The process of testing the circuits is divided into four parts: Arduino Mega 2560 circuit,20 V boost converter circuit, Ink driver circuit and printer moving circuit.

**6.1 Arduino Mega 2560 circuit:** This circuit is to test whether Arduino Mega 2560 could give the control signals to the Ink driver. The codes are implemented and the output is seen on the digital oscilloscope in Proteus.

Fig.13 Testing results of Arduino Mega 2560 circuit

**6.2 20 V boost converter circuit:** This circuit is to test whether the 20 V boost converter is ableto supply the boosted 20 V power from 12 Vinput supply. 20 V boosted output voltage isobserved on the digital oscilloscope.

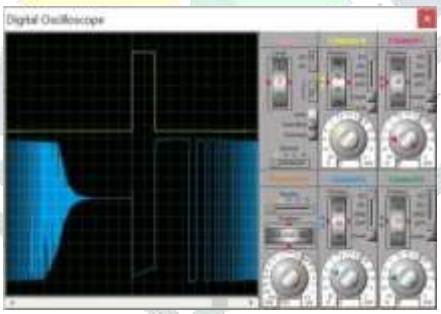

Fig.14 Testing results of 20 V boost converter circuit

**6.3 Ink driver:** This circuit is to test whether the corresponding ports of the ink driver are receiving the control signals from the Arduino Mega 2560. Two ports out of 16 are connected to the digital oscilloscope andthe output waveforms are observed.

Fig.15 Testing results of Ink driver circuit

**6.4 Printing Moving circuit***:* This circuit is to test whether the Arduino is able to control the motor driver to move on the paper. Output waveforms across the motor are observed onthe digital oscilloscope.

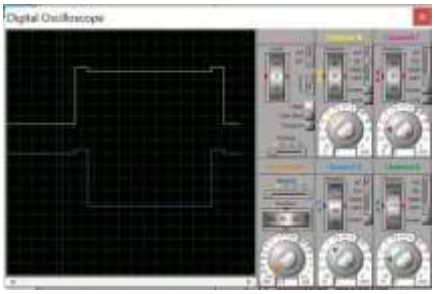

Fig.16 Testing results of printer moving circuit

## VII. CONCLUSION

We tend to conclude that our printer could print as clearly as other inkjet printers and it is very different from traditional printers. Our printer couldprint wirelessly on the different paper with various sizes and the volume of our printer could be smallerthan any other printers in the market. In the near future, with the improvement of integration of our printer, we would make it become a printer which can be really put in your pocket.

## ACKNOWLEDGEMENT

With immense pleasure, we hereby take the privilege to present our project report on"Automatic Paper Crawling Pocket sized Chargeable Printer with Wireless Connectivity". We would like to express our special thanks and gratitude to those who gave their valuable time in helping us in completing this project. Expressing our sincere gratitude and thanking our project guide Prof. Utkarsha Pacharaney for her constant support and guidance. We would like to thank our H.O.D Dr. D. J. Pete and our principal Dr. S. D. Sawarkar for providing us all the required facilities for completion of the project. Also, we would also thank the teaching and non-teaching staff of Datta Meghe College of Engineering and our friends who directly or indirectly helped us a lot for completion of this project.

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