PORTABLE BLUETOOTH PRINTER

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Certificate

We accept the work contained in this report as a confirmation to the required standard for the partial fulfillment of the degree of BS(EE).

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Head of Department	Supervisor
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Internal Examiner	External Examiner

Dedication

This report is devoted to Allah Almighty, our dear parents and the support they have delivered to me through this final year project and finishing the course at large. It is to our beloved supervisor Madam Maryam Iqbal and Head of Department, Dr. Junaid Imtiaz.

We must say that this report is a result of your interminable assistance and direction and therefore is dedicated to you. Your endeavors and supportive gestures have outfitted us towards accomplishing our expert dream. You have empowered us to see the future, obviously and may the Almighty God favor you all bounteously.

Acknowledgements

It’s our pleasure to thank the Almighty GOD for having enabled me to complete our final year project successfully. All Glory and Honor back to Him. We wish to thank our dear parents and all well-wishers for their support and facilitation. Our sincere gratitude and special thanks to our supervisor Madam Maryam Iqbal, for all the support, encouragement and the guidance she gave us since this project process begun. This has been achievable because of their constant guidance.

Our sincere appreciation to Madam Maryam Iqbal for the help given to us during our field research and consultation while gathering the data. We would like to extend our appreciation to Dr. Junaid Imtiaz for his tireless effort in coordinating and us throughout the project period. Special thanks go out to us. We are very grateful to us for being so hardworking and supportive towards the success of this project.

Abstract

Many students, lawyers, teachers and entrepreneurs work efficiently in their homes and office. Portable computers have become the need of every office. But portable printers are still not very common. Some people need to travel very frequently, and they need to print all the time, for them it is hard to find a printing place. And that is why we have chosen this project of portable printer which you can carry anywhere. It is a portable Bluetooth printer interfaced with a microcontroller-based system. A user can send a message to the printer from his laptop or tablet. An application is used to send a message to the microcontroller-based system using Bluetooth signals. We have used INKJET printing technology. We just have to put the printer on the surface, and it will automatically move and print.

Normal printers we see every day have a print head moving on a piece of paper. Our main objective is to eradicate the unnecessary parts and just put the print head on small wheels and let it move on the piece of paper. By achieving this, we will be able to make it as tiny as possible.

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Chapter 1
Introduction

1.1. Background

This project is an Inkjet printer interfaced with a microcontroller-based system that is able to print text images or logos on a piece of paper. Users can send a message from a laptop, or tablet. Bluetooth signals are used to send a message to a microcontroller-based system.

Bluetooth signals are used to send the message to the microcontroller-based system. We used inkjet printing technology which is discussed in detail below. In our project, we just have to put the printer on the surface, and it will automatically move and print. It prints in a straight line.

The fundamental concept is to make clients experience extravagant in terms of unwavering consistency and adaptability, and to help them use each of their devices in a consistent manner. In this setting, it may be argued that WLAN is the existing device management standard and could thus have been used to obtain the equivalent. However, the reason behind the emergence of Bluetooth as a standard and its widespread acceptance is the result of Bluetooth's clear emphasis on the brief proximity of specially designated systems administration without the need for a pre-determined base. Since the working reach regarding separation and speed of WLAN is a lot higher, WLAN modules devour fundamentally more vitality rather than Bluetooth gadgets. Bluetooth gadgets regularly work over an exceptionally short scope of 1 to 10 meters and consequently expend next to no power. Bluetooth can subsequently be utilized to interface fringe gadgets remotely in this way dispensing with the requirement for different sorts of communication cables.

1.2. Objectives

The chief objective of this printer is to make printing available anywhere and making it easy and fun to use. There are many students, lawyers, teachers and businessmen working efficiently in their homes and office but are having problem to find a place to print. There are different shops in different areas and it's difficult to find a printing shop especially if you're in a new area. For those that need to fly regularly, the printer cannot be found anywhere, at any moment, and seems helpless when passing business papers. When comparing and evaluating some electronic devices, it is impractical to take the printer with you and it is also difficult to look for a location for printing.

Normal printers we see every day have a print head moving on a piece of paper. Our main objective is eradicate the unnecessary parts and put the printing head on omni wheels and let it move on the piece of paper. By achieving this, we will be able to make it as tiny as possible. It will have a battery that is rechargeable with an on and off switch, it can be connected to any device that has Bluetooth.

As we all know that we are moving toward an era where technology will take place of everything. We thought we should also contribute something in it. So we are going to create a portable printer that is easy to use and is fun, can be taken anywhere, prints from devices that has Bluetooth such as laptop, tablet.

1.3. Description

We're have used inkjet printing technology [7]. Generate digital images by propelling ink droplets to the surface. It has a huge number of high-precision microscopic nozzles with a diameter of around 10 micrometers. The ink is expelled from the nozzle[9] by applying a pressure pulse to the fluid ink in the supply tube. The ink is poured onto the paper, and the nozzle draws more ink out of the cartridge. The printer arm passes the cartridges around the paper while the images are drawn. And this is how the printing of inkjet is achieved.

In recent years, requirement for portable printing has been slowly growing. Any "portable printers" have started to emerge on the market, such as Epson's WF-100, Canon's SELPHY CP1200, and so on. These printers, though, are either a little slower, or they can print very small papers and cards. The technical flaws that occur in the printer itself have not been detected and addressed. Just the scale of each component is minimized on the basis of the structure of the conventional printer, which has no necessary invention. We used mini wheels to minimize the scale and shift the printer and to prevent deformation of the paper during the movement of the printer. Let's see a block diagram of what we have achieved. In figure 1.1, we can see that everything is interconnected. First, we connected our motor with the wheels and made a base. Above that

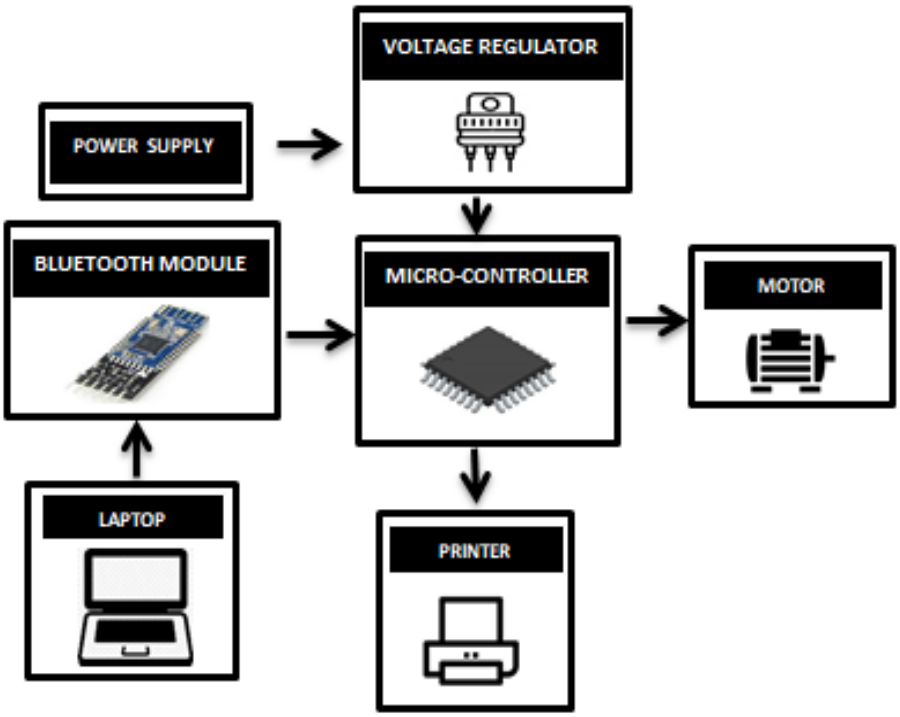

Figure 1.1 Block diagram of the proposed system

we connected the inkjet printer and our microprocessor. We programed it in such a way that the printer moves in exact desired location and prints without any error. Bluetooth signals are used to transmit the data wirelessly using Bluetooth module to the printer.

Bluetooth can subsequently be utilized to interface fringe gadgets remotely in this way dispensing with the requirement for different sort of communication cables.

This printer is small lightweight and easy to use. It can be taken anywhere. It is easy and fun to use. It is less expensive and much smaller in size.

1.4. Scope

We are trying to improve the productivity of different workers such as employees of a company, students, entrepreneurs etc. One way to do this is by supplying them with the best technology and tools for their work. Mobile printing solutions allow staff to print at a wide range of locations, as no PC workstation is required. Getting a print right away will theoretically help them finish projects in a quicker timeline. This printer would add creativity to printing technology. Ink jet printers are very common because they are easily available and this equipment is found in almost every home and are also used by officials in offices. It has a huge number of high-precision microscopic nozzles that are ejecting ink droplets on the paper. The diameter of these nozzles is about 10 cm.

portable printers are starting to play a subsequent role in a large number of companies. Restaurants use portable printers to generate credit card receipts, different shops use them to manage goods receipts, and even other companies rely on them for a variety of different kind of businesses. If you're working in retail, hospitality, transport or logistics, there's no doubt that you'll have met a mobile printer at some point. It has a huge number of high-precision microscopic nozzles with a diameter of around 10 micrometers. The ink is expelled from the nozzle by applying a pressure pulse to the fluid ink in the supply tube. The ink is poured onto the paper, and the nozzle draws more ink out of the cartridge. The printer arm passes the cartridges around the paper while the images are drawn. And this is how the printing of inkjet is achieved.

We're out-of-the-box designers and care about architecture and use of the product, and we know there's a better way to do stuff today and we're trying to change our lives through the evolving consumer robotics sector. We developed a new kind of smart printer, enabling the printer to reach the office area for the first time, significantly extending the versatility of conventional printers.

Chapter 2
Literature review

2.1. Printing technologies

The operating theory of a dot matrix printer (Figure 2.1) is that the code transmitted by the transmitter is sent to the printer's main controlling circuit after the printer's input interface circuit has been processed. Under control of the software,

Then the characters are encoded and graphics are generate to pushes the print head to take ink from the cartridge and print a column of matrix graphics; after a line is written, the paper feed process is started to feed the page. Sample output of a dot matrix printer can be seen in Figure 2.2.

Figure 2.3 Dot matrix printer

Figure 2.2 Sample output of a dot matrix printer

Next, we moved toward thermal printing technology (Figure 2.3), but it has a few drawbacks. It will heat up our device and it only prints on heat sensitive paper which will cost a lot than the normal paper. No one wants to spend extra money on a piece of paper. So, again we dropped this idea. Now, we are approaching to utilize Laser printing technology in our project.

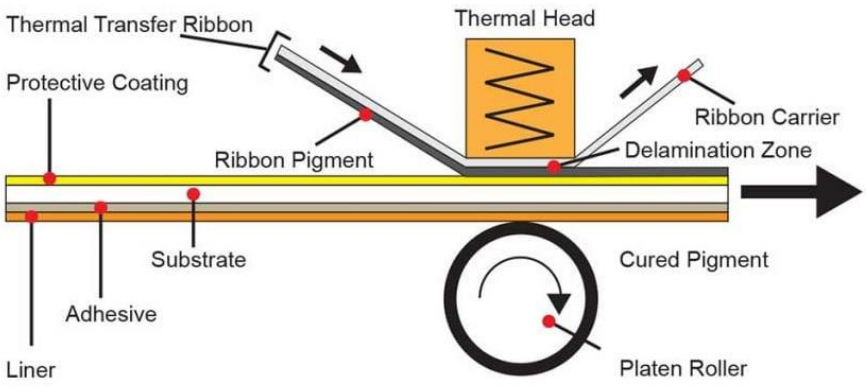

Figure 2.1 Thermal Printing

There are many pros and cons of other printing technologies such as the thermal printing method requires heat-sensitive paper and that’s is chemically treated that blacken itself when it passes under the process of thermal printing. Thermal printing requires special kind of

paper and that's the problem of thermal printing. Few cons[5] of this technology are:

- Becomes too hot sometimes and they drop too much ink on the paper.
- Sometimes the colors are too dull and not so vibrant.
- Ink sometimes take a lot of time to get dry

Then there is inkjet printing technology which is used in this project. The working theory of an inkjet printer is exactly the same as the theory of a needle printer. The biggest distinction is the difference of the print head. The print head of the inkjet printer consists of myriads of ink channels of incredibly small diameters that is 10 to 12 nano meter. The number of these channels and the inkjet printer nozzle holes specifically decide the printing accuracy of the inkjet printers. There is an actuator unit within each channel that sometimes produces heat and vibration. As the main circuit of the print head receives a signal of driving, it runs these execution units to vibrate, squeeze and drops out the ink in the channel; and it produces high temperatures, heats the ink in the channel. This is the underlying concept of piezoelectric and inkjet print heads. The control theory and operating process of inkjet printers is essentially the same as that of pin printers, but we're not going to go into depth here.

From the above discussion, it can be found that the key distinction between a laser [6], needle and an inkjet printer is that the laser printer can print a whole page in one go, whereas both the needle and the inkjet printer have to print back and forth and in lines. Therefore, under the printing conditions that are same, the laser printer is much faster than all the other types of printers, which is therefore desirable for laser printers[4].

2.2. Method of inkjet printing technology

Then there is inkjet printing technology which is used in this project. The working theory of an inkjet printer is exactly the same as the theory of a needle printer. The biggest distinction is the difference of the print head. The print head of the inkjet printer consists of myriads of

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Figure 2.5 PrintBrush Hand-held Printer

2.3. COMPARISON WITH EXISTING PORTABLE PRINTERS

2.3.1. HAND-HELD PRINTERS

Portable handheld Bluetooth printers are also commercially available few of them are shown in Figure 2.5, 2.6 and 2.7.

But they have certain disadvantages because you can't print a straight line with a handheld printer since a human hand is always shaking and can't draw a straight line.

Even, those printers are very costly and they can't print on A4 sheets printed on special papers and small cards, so you can't print the entire paper with them.

Figure 2.6 Reiner Hand-held Printer

So, we've used wheels in our printer that allow the printer to move freely and print easily on paper.

Figure 2.7 Industrial Hand-held printer

2.3.2. ZUtA ROBOTIC PRINTER

A ZUtA lab printer shown in Figure 2.8 is also a portable printer. This mini printer is 10 cm in diameter, compact and very light in weight. It fits with any smartphone, tablet or PC you use. It shall help android, iOS, Windows, OS X. No driver is allowed to use it. It runs over the page to print instead of the other way around. You can print up to 100 pages per cartridge. Currently, it just prints in grayscale, no color printing as of yet. It costs more than $199.99. This revolutionary printing robot slips into your pocket.

The ZUtA pocket printer is the most portable printer to date. It is very thin, with a diameter of 12.2 cm and a weight of 4000 grams. Since it was funded by Kickstarter, the Israel-based ZUtA Labs have been working on the printer ever smaller and quicker.

Figure 2.8 ZUtA Pocket Printer

There are certain drawbacks of this printer. It's a little slow at a pace of 1 page per minute, and a full charge lets it print for half an hour. Currently, the printer only prints in grayscale, and that's a major concern since the charging period is too limited and too fast for good use. So, we're going to push this to the next level. We're going to increase its printing speed and its

charging time.

2.3.3. PRINCUBE

Figure 2.9 Hand-held printer-Princube

Princube's revolutionary compact design sets users free from the desktop shown in Figure 2.9. It is wireless, works over Wi-Fi and is compact and ultra-portable. It's only 72x51x68mm compact enough to carry into a pocket or shoulder bag and travel anywhere. The adjustable design makes it easy to print with a single hand and only 160g (including a print cartridge) of the smallest printer available today. Princube's contemporary structure allows it portable, ergonomic and stylish. With ease of use in mind, all printing activities can be controlled using a single print button.

It charges using the latest USB Type-C port that is preferred for the reliability and fast throughput of mobile devices.

It also has some problems like it doesn't have wheels so you cannot print a whole page with it and you cannot print a straight line with it because you have to move it with your hands.

Chapter 3
Requirement specifications

3.1. Existing systems

There are a few existing systems which can be modified into a portable mini robotic printer.

3.1.1. Zuta printer

Devices are becoming more and more portable these days. This is possible because of the advanced components and technology. Printers are being used since ages and while they have advanced a lot, still there are not a lot of printers that are compact and well-matched with all the devices. Well, this changed with the Zuta portable printer; it is a fun small portable printer compatible with anything that supports Bluetooth system like your mobile phone, tablet or laptop.

Figure 3.1 Existing System- ZUtA Printer

This mini printer is 10 cm in diameter, its small and very light weight [1]. It uses any smartphone, tablet or PC. It connects with

android, iOS, OS X, Windows. No drivers are required touse it. It runs on the paper to print and prints. It can print up to 100 pages per cartridge. It currently prints in grayscale only, there is no color printing. Its price is around $199.99. This printing robot fits in your pocket. The ZUtA portable pocket printer is the smaller printer till date. Its diameter is 12.2 cm and weighs in at 4000 grams. Since its funding on Kickstarter, the Israel based ZUtA Labs has been working on the printer even smaller and faster.

This printer has few limitations; it has a very slow speed at 2 page per minute speed and a completely charged battery lets it print for half an hour [7]. As of now, the printer only prints in grayscale, and that's a big problem because the charging time is too low and insufficient

for proper use. So, we are going to take this to the next level. We will increase its printing speed and it's charging time.

3.1.2. Princube

Princube is one of the smallest printers yet. It has bought a now innovation in printing and taken it to the next level. There's a lot of demand of printing on regular A4 paper. Princube is connected via Wi-Fi with your phone or laptop or tablet. Its so lightweight and small tat it can be taken anywhere.

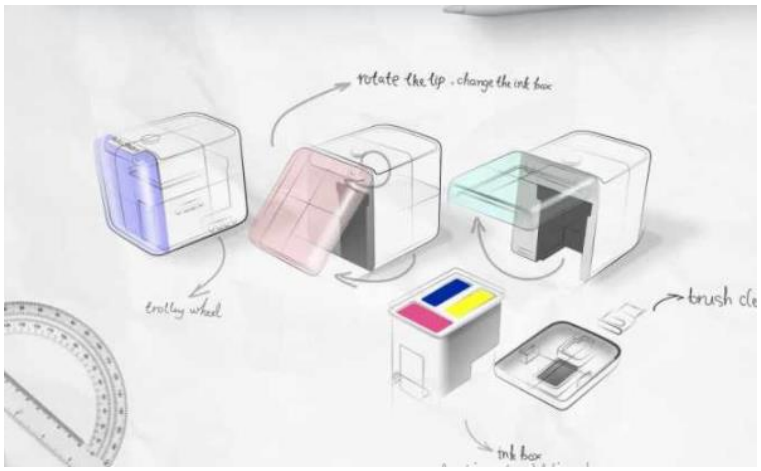

Figure 3.2 Princube structure

It uses latest thermal inkjet printing technology. It has only on button that turns it on and by pressing that button a user just have to move the printer by hand and it will start printing. Utilizing this mini printer, a user is able to print any kind of image or text or logos. It can print out messages; those messages might consist of lines that are stacked of text. According to the makers of princube, it has a lithium battery of 900mAh which can last for up to 6 hours straight. 1 full cartridge is able to print about 400 pages. And its weight is about 180 grams. Its efficiency is much more than other mini printers because it prints out high quality images. It has a cover at its bottom that protects the print-head when put into pocket or a bag.

Figure 3.3 Princube

3.1.3. Primera trio

Primera trio is the world's smallest printer that can print on A4 paper. Unlike princube it can

print a whole paper and you don't have to move this printer with your hand. Regardless of its small size it has all the other functionalities that you can expect from a normal sized printer. Its weight is just 1.2 kg it can scan, print or copy so it can be said to have multiple functionalities. Due to its small size, it can be out in a bag or a briefcase and you can take it anywhere you want. Its identical to a normal inkjet printer. Its scan resolution is 600x600 dpi. And its full color printing quality is 4800 dpi. It can print up to 3 pages per minute in color and about 2.3 pages in black and white. And its scanning speed is about 1.4 paper per minute. The problem is that it require some system specifications like it works only with a system that has at least 2 GB ram and OSXv10.6 or higher.

Figure 3.4 Primera Trio

3.1.4. Kodak mini 3 retro 3x3

Kodak mini 3 retro 3x3 has stunning size and print quality. It can be connected to any mobile device and can print any kind of image. Its connected via stable Wi-Fi connection. Its used to print high quality photos. It doesn't print on A4 sheet and that's its drawback. You can get supreme quality 3x3 photos using it. it uses laminating process to print

Figure 3.5 Kodak mini 3 retro 3x3

images in layers of ribbon. The images printed from this printer are resistant to fingerprints and water. It uses its own app that is kodak app through which it is connected to your device. It makes the printing very easy. It uses 4pass technology that means the printer moves the paper back and forth over the print-head. It can print a photo in just less than 50 sec. this is much faster than other photo printers. It uses dye-sublimation technology and ink paper cartridges. Per full charge it can print up to 25 photos but when it comes to printing on A4 papers, this printer is futile.

3.2. Proposed system

This system uses a micro-controller based circuitry interfaced with a printer to fulfill its purpose. System transmits the text data, images and documents to be printed through the printer to the circuitry that is received wirelessly via Bluetooth module. Then the data is received by micro-controller and processed and then is transferred to the printer. The data is then processed using controller and prints as per user's requirement. For the design, we started from hardware development that included a print head which will move on the paper. We used a raspberry pi and connected motors with it and then programmed it in such a way that the printer moves at the exact desired location and for precise movement, micro stepper motor is used. The printer has its printing cartridge at the bottom of the printer. The cartridge lasts for 50 pages and the battery lasts for over one hour [1]. Our printer is based on précised wheel system that allows it to accurately turn and drive in any desired direction. The printer is designed in a manner which helps the user place the printer properly at the top of the page and guarantees an accurate output. Normal printers we see every day have a print head that moves left and right on a piece of paper which is moving. Our main objective is to get rid of the entire printing device and only put the print-head on small wheels and let it move like a robot on the piece of paper and print. If it is achieved, we will be able to make printer as compact as possible.

3.3. Requirement specifications

Following components will be used in this project:

- **Raspberry pi and its casing**

The Raspberry Pi is a cost effective, small sized computer that plugs into a monitor or TV. It uses a standard keyboard & mouse. It easily allows people of all ages to explore computing, and to learn programming languages such as Python.

Figure 3.6 Raspberry Pi Controller chip

Specification table:

System on chip	Broadcom BCM2836
CPU	900MHz quad-core ARMv7 Cortex-A7
GPU	Dual core Video Core IV multimedia Co-processor
RAM	IGB LPDDR2 SDRAM
Ethernet	Onboard 10/100 Ethernet RJ45 jack
USB	Four USB 2.0 Connectors

Table 3.1 Raspberry Pi specifications

- **Battery 12V DC**

Dimensions (body)	150x64x92mm
Weight	1.96kg
Dimension (battery terminals)	4.8x0.8mm
Voltage	12vdc
Capacity	7ah
Technology	Seal lead acid
Cycle use	14.5 to 14.9 v dc
Standby use	13.6 to 13.8v dc
Initial current	<2.8a
Standby charge voltage	13.8v
Estimated standy time (1 terminal 1 set of door lock)	7 hours

Table 3.2 Battery specifications

- **Bluetooth module**

Figure 3.7 Bluetooth Module

Operating Frequency Band	2.4GHz-2.48GHz unlicensed ISM band
Bluetooth Specification	V2.0+EDR
Output Power Class	Class 2
Operating Voltage	3.3V
Host Interface	USB 1.1/2.0 or UART
Audio Interface	PCM and Analog Interface
Flash Memory Size	8Mbit
Dimension	26.9mm (L)x13(W)xmmx2.2mm(H)

Table 3.3 Bluetooth module specifications

- **Inkjet Printer mechanical parts**
- **Inkjet printer microcontroller**

Figure 3.8 Inkjet Printer Micro-controller

- **Ink cartridge Holder**

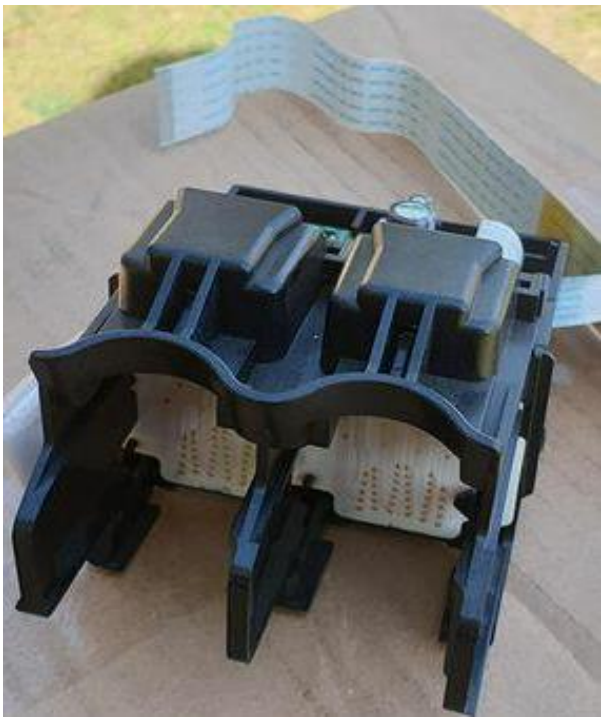

Figure 3.9 Ink Cartridge holders

- **Ink Cartridge**

Figure 3.10 Ink Cartridge

- **Omni Wheels**

Figure 3.11 Omni Wheels

- **DC motor**

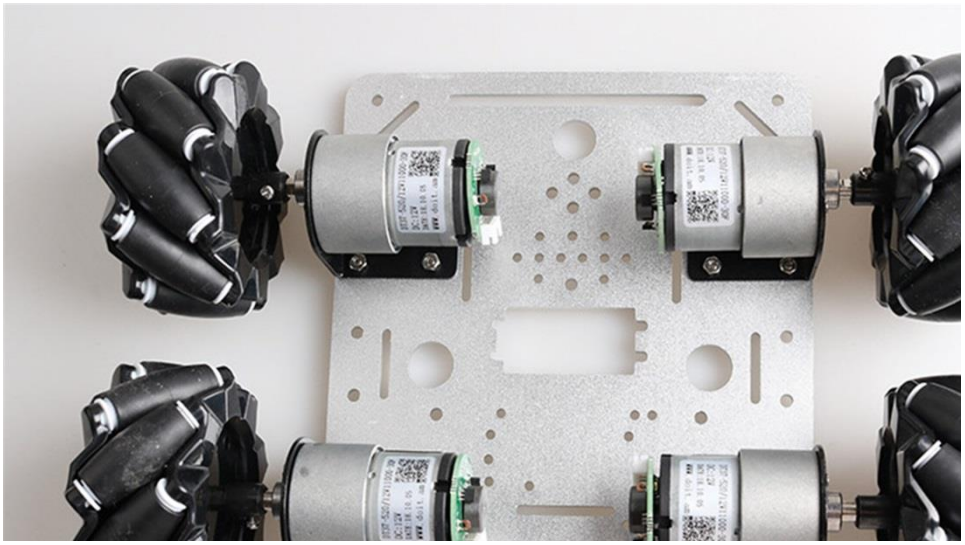

Figure 3.12 Dc motor

Chapter 4
System design

4.1. System architecture

The future of portable printing is starting to roll over an A4 sheet of paper. Its is neither a tpical boxy table to ink-jet nor a version scaled down rather this printer is a standard inkjet device. This is small robot in size have four wheels and a printer cartridge which is programmed with a Raspberry pi as shown in Figure 4.1.

Figure 4.1 System Architecture

The robot spreads ink by rotating on the whole A4 page on set of two on wheels instead of feeding papers via stationary equipment with a running cartridge. For anybody who wants to print conveniently and efficiently, it's simply a solution out of the box.

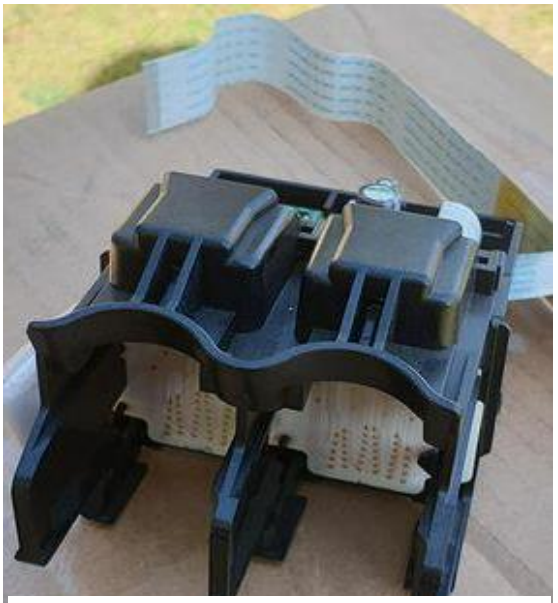

Figure 4.2 Standard Size Ink Cartridge holder

The printer's final edition is reduced by about one third. The basic architecture of the system is that we have gotten rid of the whole printer body and all its bigger mechanical parts. And we just used the basic and main printer components in order to reduce its size. Here the process is to first put the ink cartridge and second to print head on the wheels and we are letting it move on the paper using the small wheels.

4.2. Design constraints

Since this robotic Bluetooth printer is a very efficient device it has a few restrictions.

- It prints one A4 page per minute as it is little slow.
- Its charging lasts for just one hour.
- We are working to increase its battery time in the next iteration.
- Its size is a bit larger since it's just a prototype.
- Also due to smaller size we were able to put smaller ink cartridge inside this printer so it can print only few pages with 1 full cartridge. Standard size ink cartridge holder is shown in Figure 4.2.
- It prints only 20 to 30 pages with one cartridge if you want to print more pages you will have to refill the cartridge. So that can also be counted as its limitation.

No doubt the printer is productive but with this size it will be hard to carry it as a portable printer. Note that the printer will be smaller in size when it's made in the industry and we will use some ways to put a cartridge that makes the printer able to print more than 100 pages with just one filled cartridge. The printer will be a lot inexpensive when it's made in bulk. This printer is printing only in greyscale at the moment because of the size issue we cannot use more than one cartridge inside the printer. So, we just used one that is why the printer is printing only in greyscale at this moment we are thinking about making it to print color images in the next iteration.

4.3. Design methodology

Our design methodology is that first we took some main components of the printer like print head which is a very sensitive component. The printer head is basically a component that pushes ink from the cartridge on to the paper. It uses multiple printer dots to produce a desired print by shooting tiny droplets of ink. If you block one of these nozzles, the prints

look faded or striped. Then we took the ink cartridge. The ink cartridge is an inkjet printer component which contains the ink that is stored on the paper while the ink is being printed. Each ink box includes one or more ink tanks. Then we removed the unnecessary mechanical components of the printer. Then comes raspberry pi which we programmed in such a way that it moves in exact desired location without any error with raspberry pi we connected motors using motor drivers and we used Omni wheels. Omni wheel is and all-round wheel is like conventional wheels rolling forward but are sliding sideways with almost no friction (no skidding during turns). It lets the printer roll in any direction with these wheels. It normally works on 20-21 volts. The ink cartridge also takes 20-21 volts.

4.4. High level design

The code given below in Figure 4.3 is the raspberry code for motor movements, stepper motors are controlled by this code when it is burned to the raspberry pi. The stepper motor [11] is used for accurate and precise placement unlike other dc motors stepper motor rotates in steps and each step is a measure of the movement. It is used where high precision movement is required, such as hard discs, robots and antennas, telescopes and some toys. Stepper engines cannot operate at high speeds but have a high torque of keeping. So, we have used stepper motors in this printer so that we can achieve maximum precision.

With stepper motors, our printer will print one line then comes back to the initial position then with the help of Omni wheels [14] it makes downward movement and starts printing the next line this all is done with the help of this code and the raspberry pi see appendix C.

4.5. Low level design

In this simulation the message is being given to the printer through wires because there is no Bluetooth module in Proteus. So, we have used wires. The message is interpreted by the raspberry pi and then transferred to the motor drivers. Motor drivers are an interface between microcontroller and control circuits. Since the signal from the microcontroller is not so strong to driver the motor, so this motor drives transforms the low current signal into a higher current signal to drive the motor.

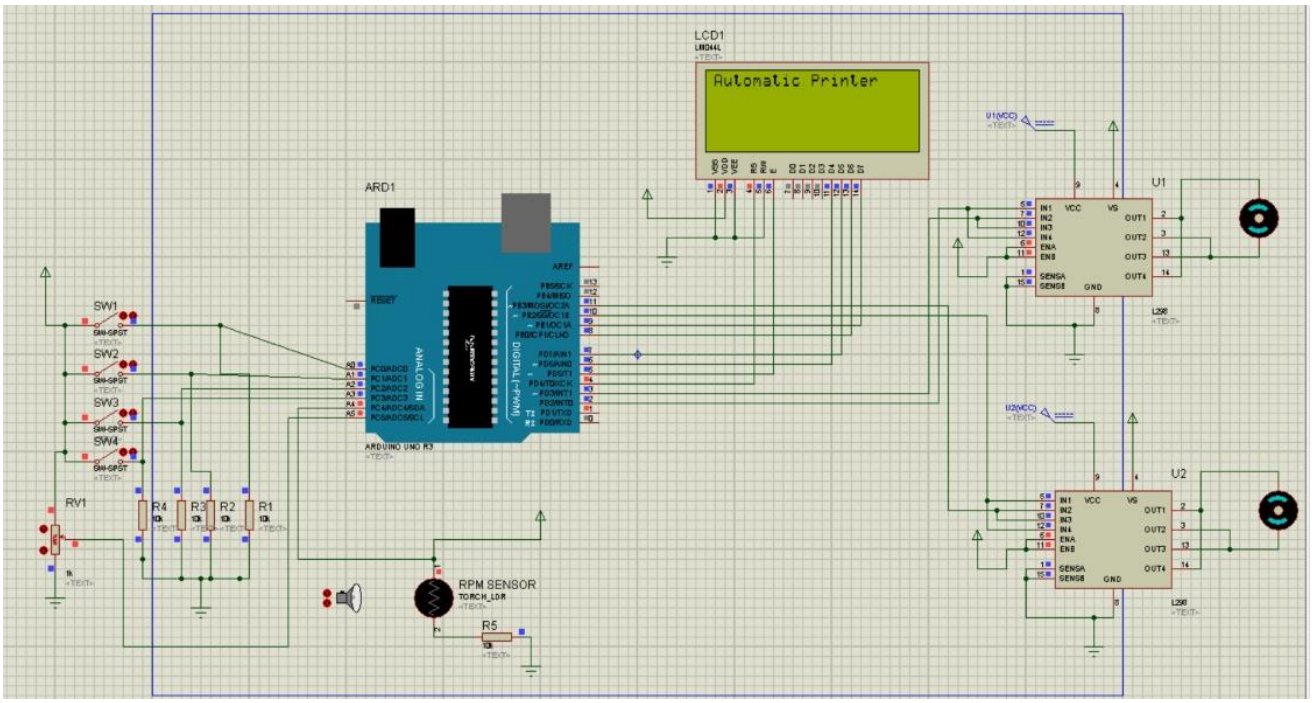

Figure 4.3 Low level Design-
Proteus Design

Chapter 5
System implementation

5.1 System architecture

A slice of A4 paper rolls steadily in the future of portable printing. It is a standard ink jet unit and not a traditional inkjet boxy tabletop version of your printer. It is a robot, with a raspberry pi, having four wheels, a printer cartridge, and the print head.

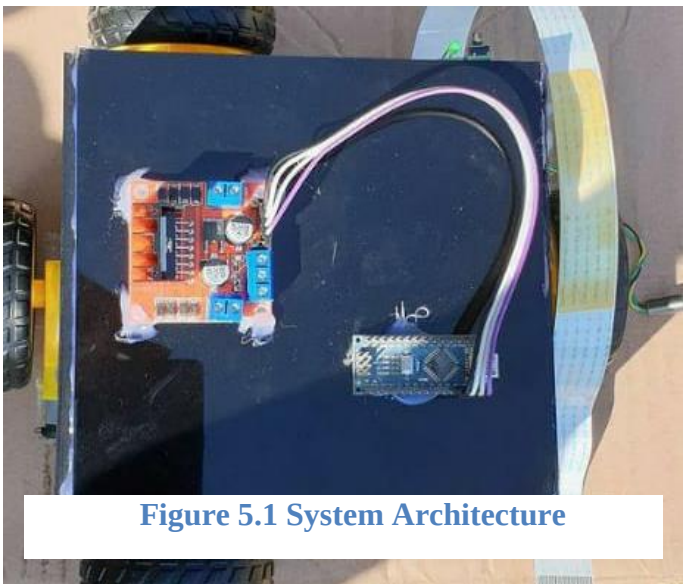

Figure 5.1 System Architecture

The ink is distributed by spinning the complete page on two bidirectional wheels rather than ordinary method followed by stationary machine with a moving cartridge. It is basically a solution out of a box for anybody who needs to print comfortably and easily.

The final version of the printer is reduced by about one third. The system's basic configuration is that the whole printer body and all its mechanical components have been removed. And we just used the key components of the printer to reduce their bulk. We have placed the ink cartridge and the printer on the wheels and let it roll with tiny wheels on the page.

We connected our motor with the wheels and made the base. Above that we connected the inkjet printer mechanical parts and our micro-processor [13]. We programmed it in such a way that the printer moves in exact desired location and print without any errors Bluetooth module is used to transmit the data wirelessly to the printer. A Bluetooth module with a limited range of approx. 10m, in which both sound and data transmission is provided. At 2.4 GHz transmission and receiving frequency band range of the Bluetooth device which is a available all over the world. We attached wheels with the motor and built a foundation. Above, the print head and other mechanicals of the printer, our microprocessor is connected.

We have programmed it to move the printer to the exact position desired and print error free. A smartphone interface is used for the wireless transmission of data to the printer via the Bluetooth module. A Bluetooth module offers both acoustic and data communication as a short-range unit of around ten meters. The Bluetooth is transmitted and received at a worldwide usable frequency range of 2.4 GHz.

5.2 Tools and technology used

Following tools have been used in the project:

- Raspberry pi

This is a mini-CPU that can be connected to either a television, a computer or even a monitor. It uses easily available Keyboard and mouse. It gives people of every age to start exploring computers. It has outstanding power and a very quick response it comes in different models having different memory. It has general input and output ports that allow you to control many electronic components with it.

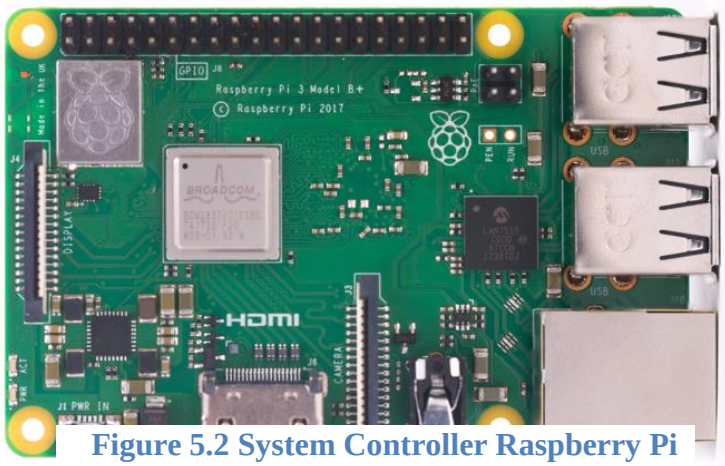

Figure 5.2 System Controller Raspberry Pi

- Battery, Battery holders and Battery charger

As the printer has rechargeable battery so it also has a charger and the battery holder where

the battery will be placed.

- WiFi module

This module comes pre-programmed from the company. This module is powerful enough for on-board processing. This allows it to be integrated with different kind of sensors and applications. Its is designed to use up just a small portion on pcb.

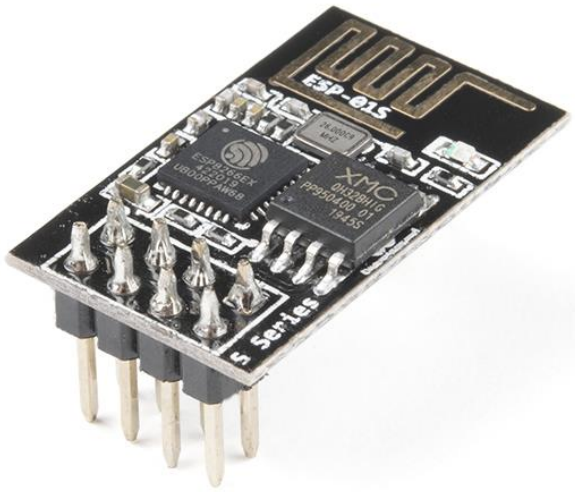

Figure 5.3 System WiFi Module

- Programming cables and RJ45
- Printer mechanical parts
- Limit switch
- Cartridges refillable
- Drive mechanics
- Battery monitor system
- Imported adapter
- Raspberry pi coding
- A4 boundaries
- Connection wires

5.3 Development environment/languages used

We have used Python[10] as our programming language. Python is a code of interpretation, high quality, and general use. Python is also used to help app developers, control and management building, testing and many more. The language of the future will be Python. Testers will need to improve their knowledge and learn the AI and ML methods in these languages. In recent years Python has perhaps not had bright, but in the 21st century it experienced a consistent and astounding growth pattern.

Chapter 6
System testing and evaluation

System testing is the very important part in the development of any project. Through testing you should analyze what are the limitations in the project and what further improvements can be done. As mentioned earlier that our objective is to make that vehicle that goes in underwater at desired depth. It will also give the view of the underwater environment through the camera attached to it and it gives different type of data through different type of sensors attached to it. After successfully implementing and assembling all the project components. we have tested our vehicle and all the motors and the water proofing of electronic components before the final testing in underwater.

6.1. System testing and evaluation

There are different kinds of printers available in the market. There are inkjet printers, thermal printers and laser printers. All have their own pros and cons. Having a printer in home has countless advantages. And having a printer that is portable makes your life much easier. A printer that is small in size and portable and connects wirelessly using Wi-Fi signals is available in the market in their prices are very high, and if there's a problem in a printer, a user will have to pay a lot of money to get it repaired. While working with this printer we faced may problems. One of the foremost problems was the unavailability of the components. The size of a common inkjet printer is very large because it needs a lot of space for its print-head to move on the paper. When we first connected the wheels with the motor, we found out that we needed Omni wheels because this printer had to move in 2 axes x and y. we needed 4 Omni wheels to make it move on the paper.

We had to face many problems while working on this project some problems were solved after some research and work however some problems are still there. We performed testing regularly after some time period and the results of those tests are given below. Following is the list of tests.

- Test with the wheels
- Test with the coding
- Graphical user interface testing
- Print-head and ink cartridge testing
- Installation testing

6.1.1. Test with wheels

When we used normal wheels in the beginning but when it moved, it crumpled the paper because of the wheels. So, we got an idea to use the omni wheels. Omni wheels rotate when powered like an ordinary wheel. The advantage is that you can get movements in both the axes while using omni wheels because perpendicular to the wheels axis, rollers are mounted so when the side force is applied it makes the to roll on the rollers. The problem with the wheels was solved.

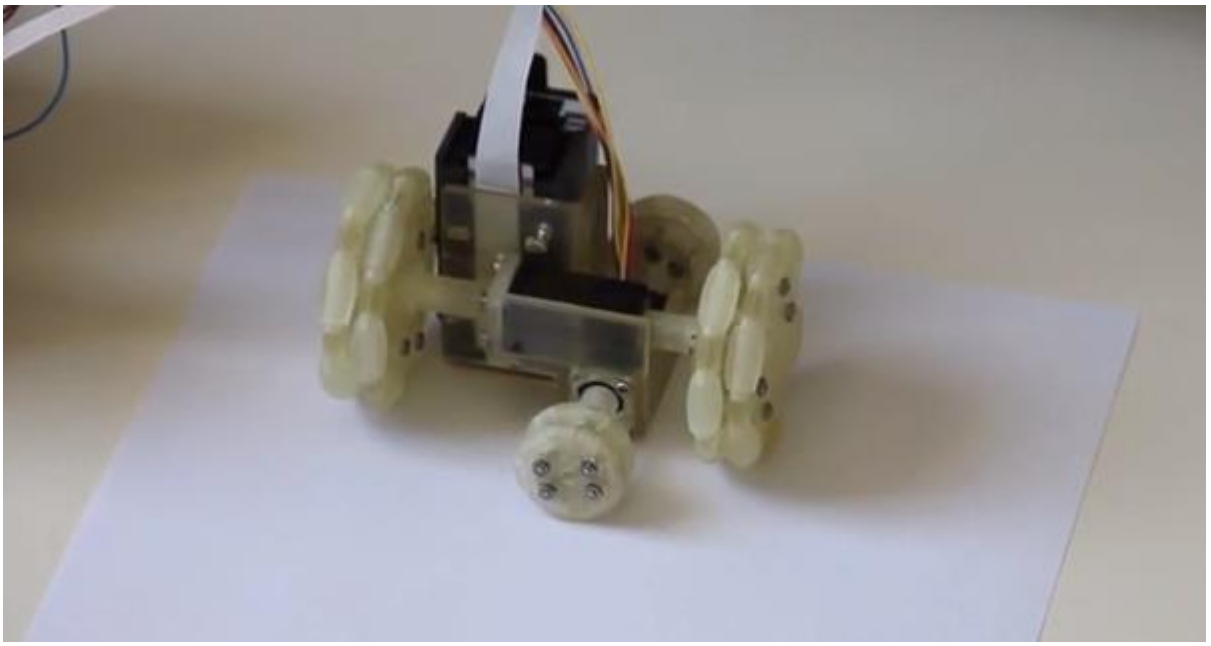

Figure 6.1 Test with wheels

6.1.2. Test with the coding

We used microcontroller Atmega 328 and to connect the wheels with it we used motor drivers. The microcontroller acts as a brain of this printer and tells where to move on the paper. So, we programmed the microcontroller in such a way the it moved on the whole paper with the help of Omni wheels. We attached motor drivers with the microcontroller and then attached wheels to it. Motor drivers have 2 H-bridges having maximum output of 45 volts and 2.4 amperes. Coding was not so easy because printer cannot move in the same direction ever time, it will rather decide where to move based on what the user wants to print. For the normal text its movement is liners but when it reaches a point where there's a heading, the size of the font becomes bigger which changes its movement. This issue has not been solved yet.

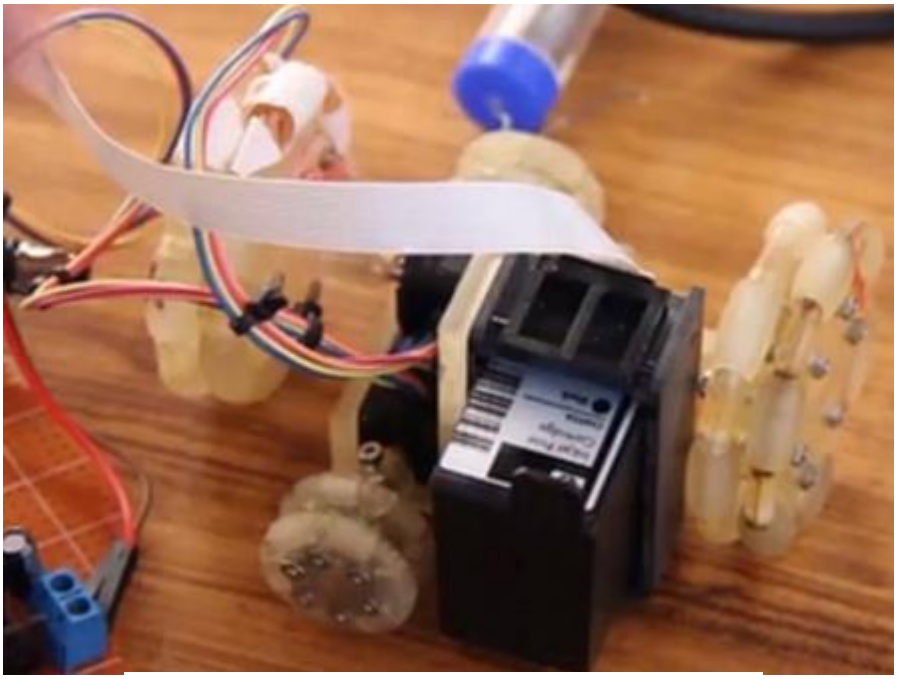

Figure 6.2 Test with Coding

6.1.3. Graphical user interface testing

We are using an application through which we will control our printer. We will give command to our printer through the application. The application is very simple and user-

friendly. The application has different options for printing on different size of paper, those options basically control the movement of printer. The application works fine and connects to the printer instantly we might make some modifications and add QR code on the printer then we will just have to scan a code to get it connected with the printer.

Figure 6.3 Application Window

6.1.4. Print-head and ink cartridge testing

We faced a lot of problems while connecting print-head and ink cartridge. First, we used print-head of different model of printer and ink cartridge of different model. When we connected them, they were not working so our test failed. Then we got to know that we have to use same model of both cartridge and print-head, but same models were much larger in size. And we could not afford a size that was not portable. Then the problem was that we had to fit all the components in a small box, batter, ink cartridge, print-head, microcontroller, motors, motor drivers and other components. This problem was solved, and we put the components in the box however the size increased a bit. Print-head and ink cartridge was

failed because we could not find a small print-head that was compatible with the cartridge.

6.1.5. Installation testing

We again faced some problems while installing the setup, like wires were the issue because they created disorder and jumble in the box. However, this problem was also solved. We managed to put all the wires in the box but, we were still facing the problem that was unavailability of print-head. And due to this problem, we were unable to perform our final testing. Our project is mostly based on mechanical parts and it is not much related to the software domain. Since our project is still in development stage, it’s hard to cover every aspect and test the final version of it. But we are hoping to make further improvements in it.

Chapter 7
Conclusion

Having a printer of your own can be very beneficial, it makes life much easier. There are many people who are working in their homes and office but sometimes it becomes and for them to find a printing place. And due to COVID-19 its not advisable to go out for printing, rather people can have a portable printer that they can carry everywhere and that can print very easily.

Normally, printers have print head that sway from left to right on the piece of A4 paper. Since the print head requires a lot of space to sway from left to right so the size of a normal printer is very large. we have reduced its size by removing the unnecessary parts from it. however, we could not reduce the size further because smaller components are not available in the market. So, we made the printhead still and let the printer move on the paper.

This printer is interfaced with a microcontroller. Language used for its coding is python. This proposed system basically solves the problem of finding the printing place because with the help of the printer people will be able to print anywhere. You will just have to put the printer on the paper, give a command to it by your phone or a laptop and the printer will start moving and printing.

As we know that the world is moving towards modernization, era is changing, and new technologies are taking their place in the industry. industries are trying to make the printer smaller and smaller. To contribute a little, we also tried something new by working on this project however dur to unavailability of smaller components we could not make this device any smaller because we cannot build the components by ourselves that are not available in the market.

In chapter 1, we have discussed the main objectives and description of this proposed project. Thein we discussed the scope of this project where and why this project is useful. In chapter 2 we discussed the printing technology (inkjet) that we are using in our project. We discussed different types of printing and why have we chosen inkjet printing for our project then we

showed some comparison of our project with other projects. In chapter 3 we discussed the already existing systems that are available in the market like Zuta printer, Princube and Primera Trio. Then we discussed our proposed system and how our project is different from them. We discussed the requirement specifications of our project the components that are used and why these components are used. We have given the detail of all the components. In chapter 4, we have talked about our system architecture, some limitations of our project, and the full design of this project. In chapter 6 we discussed the testing of our project that includes testing with wheels, testing with microcontroller, ink cartridge and print-head testing and installation testing, we found out that wheels are working fin, there were some issues with the movement of microcontroller that has not been solves yet because the project is still in development stage due to the unavailability of the components. So, we have not been able to perform the final testing of our project.

And finally, we are hoping to make some amendments in this system in future by controlling its movement accurately and using the print-head that is supported by the main circuit of the printer. After the final testing we will have successfully designed this printer that will move and print on the paper. If this project is successful, we will make it available for people in everyday life.

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Appendices

Appendix A
User manual

This portable Bluetooth printer is interfaced with a microcontroller-based system. A user can send a message to the printer from his laptop or tablet. An application is used to send a message to the microcontroller-based system using Bluetooth signals. We have used INKJET printing technology. We just have to put the printer on the surface, and it will automatically move and print.

Application Setup:

Now setup the project using the application provided by our team. Connect the hardware with the system.

Steps:

- Install the given application.
- Turn on the device.
- Turn on Bluetooth on your mobile.
- Open application settings and Connect mobile with the device.
- Upload the material to be printed.
- Put the printer on top of the paper in a straight line.
- Click on “print”.

Appendix B
Specifications

Dimensions	10’’ 7’’ 5’’
Weight	0.98 kg
Range	10-12 meter
Power supply	self-powered; 18Vsupply
Operating temperature range	-22◦to150◦F(-30◦to65◦C)
Operating humidity range	5%to95%relativehumidity,non-condensing

Table 9.1 Product specifications

Appendix C
Code

Python 3.8.2 Shell

File Edit Shell Debug Options Window Help

```
Python 3.8.2 (tags/v3.8.2:7b3ab59, Feb 25 2020, 22:45:29) [MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>> #!/usr/bin/python
# coding=utf-8
import serial, os, sys, re, argparse, string, signal

class gparser(object):
    def __init__(self):
        # Matches G-Code comments
        self.re_comments = re.compile('\s*;.*$')
        # Matches empty lines
        self.re_empty = re.compile('^\s*$')
        # Matches comment-only lines and BOM
        self.re_comment_only = re.compile('(^\s*;.*$)|(\xef\xbb\xbf*)')
        self.do_checksum = True
        self.parsed = []

    def readfile(self,fname):
        fcontent = []
        if fname == "-":
            fh = sys.stdin
        else:
            fh = open(fname)
        for line in fh:
            fcontent.append(line.rstrip())
        fh.close
        self.fcontent = fcontent

    def checksum(self,line):
        cs = 0
        for i in range(0,len(line)):
            cs ^= ord(line[i]) & 0xff
        cs &= 0xff
        return str(cs)

    def csline(self,line):
        return line+"*"+self.checksum(line)

    def prepare_checksum(self):
        self.parsed = []
        return "M110 N0"
```

Python 3.8.2 Shell

File Edit Shell Debug Options Window Help

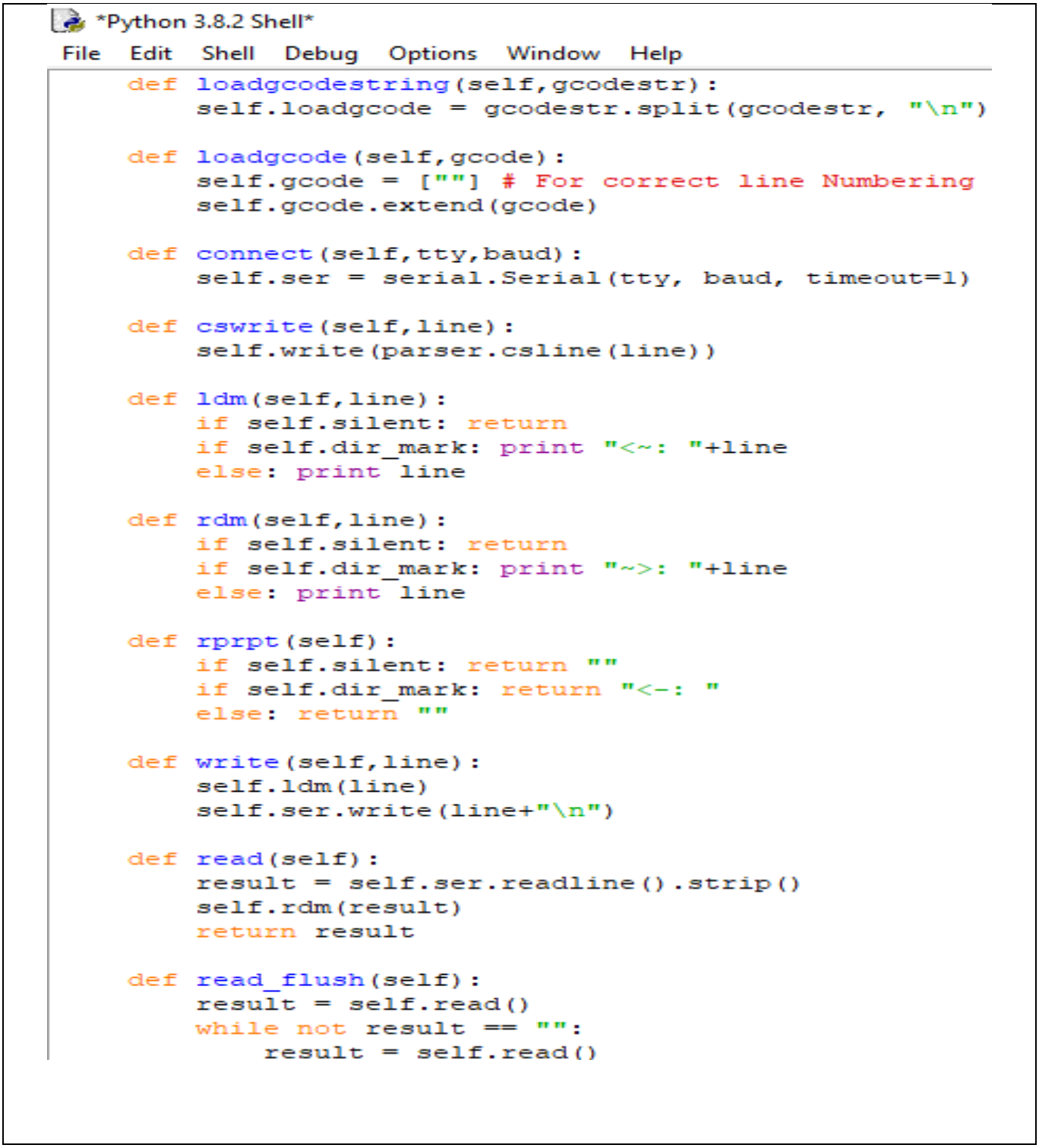
```
    def parse_file(self):
        if self.do_checksum:
            self.prepare_checksum()
        for line in self.fcontent:
            self.parse(line)

    def parse(self, line):
        if (not self.re_empty.match(line) and
            not self.re_comment_only.match(line)):
            line = self.re_comments.sub("",line)
            if self.do_checksum:
                line = "N"+str(len(self.parsed)+1)+" "+line
                line = self.csline(line)
            self.parsed.append(line)
            return line
        return ""

    def get_parsed(self):
        return self.parsed

    def dump_parsed(self):
        for i in self.parsed:
            print i

class dddprinter(object):
    def __init__(self):
        self.parser = gparser()
        # Matches Emergency Condition
        self.re_emergency = re.compile('!!')
        # Matches resend query with (optional leading n)
        self.re_resend = re.compile('(^rs [Nn]?)|(^Resend:)')
        # Matches lines which should be ignored
        self.re_ignore = re.compile('(^echo:)|(^[Mm]arlin)|(^start)|'
            '(^Error:checksum)|(^\D:)')
        self.max_resends = 10
        self.resend_counter = 0
        self.currentln = 1
        self.silent = False # output Printer communication
        self.dir_mark = True # Show direction marks
        self.gcode = [""]
```


Python 3.8.2 Shell
File Edit Shell Debug Options Window Help
def loadgcodestring(self,gcodestr):
self.loadgcode = gcodestr.split(gcodestr, "\n")
def loadgcode(self,gcode):
self.gcode = [""] # For correct line Numbering
self.gcode.extend(gcode)
def connect(self,tty,baud):
self.ser = serial.Serial(tty, baud, timeout=1)
def cswrite(self,line):
self.write(parser.csline(line))
def ldm(self,line):
if self.silent: return
if self.dir_mark: print "<~: "+line
else: print line
def rdm(self,line):
if self.silent: return
if self.dir_mark: print "~>: "+line
else: print line
def rprpt(self):
if self.silent: return ""
if self.dir_mark: return "<-: "
else: return ""
def write(self,line):
self.ldm(line)
self.ser.write(line+"\n")
def read(self):
result = self.ser.readline().strip()
self.rdm(result)
return result
def read_flush(self):
result = self.read()
while not result == "":
result = self.read()

Python 3.8.2 Shell

File Edit Shell Debug Options Window Help

```
        print "--- EOF ---"

    def resend(self,linenumber):
        self.write(self.gcode[linenumber])
        if self.resend_counter <= self.max_resends:
            self.waitforok()
            self.currentln = linenumber # Re-Send all after Checksum-Error
        else:
            self.panic("too many resends!")

    def waitforok(self):
        result = self.read()
        while (len(result) == 0 or
                self.re_ignore.match(result) or
                parser.re_empty.match(result)):
            result = self.read() # Ignore empty lines, unuseful infos, 0-lenght
        if self.re_emergency.match(result):
            # Emergency
            self.panic("received EMERGENCY CONDITION!")
        elif self.re_resend.match(result):
            # Printer queried a resend
            self.read_flush()
            result = self.re_resend.sub("",result) # removing request
            self.resend(int(result))
        elif result == "ok":
            # ok
            self.resend_counter = 0
        else:
            self.panic("UNKNOWN:"+result+":"+str(len(result)))
        return


    def _print(self):
        while self.currentln < len(self.gcode):
            self.write(self.gcode[self.currentln])
            self.waitforok()
            self.currentln += 1
        print "Print successfull :D"
        print "programm succeeded."
        sys.exit(0)
```

Figure 9.1 High level Design- Python Code