Omnidirectional Wheel Based Monochrome Portable Printer

Zafar Khan\textsuperscript{a}, Mufassir Kazi\textsuperscript{b}, Farhan Khan\textsuperscript{c}

M.H. Saboo Siddik College of Engineering, Byculla, Mumbai.

khan9226@gmail.com\textsuperscript{a}, mufassirkazi@gmail.com\textsuperscript{b}, fk015148@gmail.com\textsuperscript{c}

Abstract: In its simplest configuration, a portable printer consists of an omnidirectional wheel, gear motors and a print head used for printing. This monochromatic portable printer will work on the principle of piezoelectric inkjet technology. Supposed to be palm-sized it can be placed on top of any dimension of paper. The omnidirectional wheel renders the printer to move in the horizontal, vertical or diagonal direction as deemed necessary. It can print alphanumeric characters, paragraphs, and diagrams in grayscale. Eliminating the paper rack from conventional printers, the complexity of the same can be reduced. The movement of the printer on the paper depends on the location on which the printing has to take place. So with the help of software developed an application that can upload pdf, word or other file formats, we can find the coordinates of the page where printing is to take place. These coordinates will be transmitted via any wireless module, pertaining to which the printer will move accordingly at the desired location. Working on the principle of inkjet technology, the printer starts printing once it reaches the desired position.

Key word: Printer, nozzle, coordinates.

1. Introduction.

Conventional printers cannot be afforded by everyone. And in both cases, having a printer does not fulfill urgent printing requirements. College and school students need prints on a daily basis. In such situations running to a printing store just to end up in a queue for hours are not justified. So having a system which can meet your printing requirements regardless of place, time and size of paper can be a great help. Current printers are bulky, non-portable and area restricted. Such printers cannot be carried by everyone. Also, most of these printers are only PC compatible and further taking a print from any printing store results in loss of time and money. For those who do not have access to a printer, they can take print only from printing stores which are only open for specific timings. As far as power consumption is concerned, conventional printers due to their bulky nature consume more power. So systems utilizing more power results in an increase in electricity bills. Also as these printers are not portable, work is generally confined to printer based areas.

The main objective of this paper is to provide printing accessible to everyone around the world, on the go, anytime anywhere. We are looking to revolutionize the concept of printing. Hence increased productivity of work can be obtained.

2. Working principle.

In its simplest configuration, a portable printer consists of an omnidirectional wheel and a print head which releases ink on the area that has to be printed. This printer will be easy to carry, energy efficient, low-cost product. It will not only be both PC and mobile compatible but also an easily accessible device. This product can be commercialized which can help in usage in industries, schools, colleges, banks where the provision of printer for each individual employee or student is possible. We are getting rid of the paper rack from the conventional printers and only accessing the ink jet printer concept. This inkjet will be mounted on an omnidirectional wheel and can turn in any direction. It will print alphanumeric characters, paragraphs and diagrams.

3. Method of Analysis:

There are many technologies that can be implemented in a printer. The preferred technology on which a printer operates includes Dot Matrix technology, Ink Jet Technology and Laser Technology. We analyzed the problem and concluded the solution of making a portable printer for the dimensionless paper pertaining to that we designed an approximated physical structure. Similarly we will develop a mobile application which can be used for any file format. This documentation can be transferred to the printer via Wi-Fi module. The printer will sense the location where printing is required using the help
of optical sensor.

4. Printing area
The movement of the printer on the paper depends on the location on which the printing has to take place. So with the help of software developed an application that can upload pdf, word or other file formats, we can find the coordinates of the page where printing is to take place. These coordinates will be transmitted via any wireless module, pertaining to which the printer will move accordingly at the desired location. Once it reaches the desired point, the printer will start printing working on principle of ink jet technology. So for the mobile application part we will be using JAVA programming language. We will also be using Arduino as a processor to control the print head and omnidirectional wheel by gear motors.

5. Physical layout
The designing of the printer has been visualized as below. The dimensions have been approximated. Considering all given parameters, the rack from conventional printers was eliminated to reduce the physical complexity of the same. The physical components which need to be mounted are the omnidirectional wheel controlled by the gear motors, the print head and the rechargeable battery.

The omnidirectional wheel has dimensions of 55mm x 7mm. The print head has physical dimensions of 45mm x 28mm. considering these two physical assumptions; the actual printer will be a 120mm x 120mm system, small enough to fit in your pocket. The main design consideration for developing this system is that it should be portable and light weight for easy convenience and use.

6. Block Diagram

Figure 2. Block diagram
File which needs to be printed should be selected with the help of a Mobile Software Application or PC. This data is wirelessly transmitted to your printer through Wi-Fi module or Bluetooth module. You need to switch on your printer and place it on any dimension paper. Upon receiving the data, the printer will start printing on the paper. It is supposed to move on the printer from extreme left to right using an omnidirectional wheel based on the position which needs to be printed on. Printing is performed under the control of the processor. The ink shield is an Arduino shield which is used to boost input from 12v to 20v to control the movement of the nozzles. It also makes use of the multiplexer circuit and Darlington array to drive each of these nozzles. 4 input pins are used to address the nozzle and one pin is used for firing the nozzles. It also uses optical mouse sensor (CMOS) for tracking of position of printer. The ink discharges from the nozzles when it reaches the particular area that needs printing.

7. Flow Chart

![Flow Chart](fig3_flowchart.png)

The above is a flow representation steps on our printing process. Place your printer on any size of paper and the above steps will be implemented.

8. Prototype
The below is an initial phase model of the said prototype version. It consists of four wheels responsible for horizontal and vertical movements of the print head. The difficulties in flexibility of the movement of the printer can be accounted for if we use an omnidirectional wheel. The dc motors concepts have been implemented to control the motion of wheels.
We need a 6µs 21V pulse with a 0.5µs delay before firing a different nozzle and an 800µs delay between two pulses on a given nozzle. This was used as a starting point for driving the cartridge.

The pulse width was varied from 5 µs while holding down the voltage at 19v. This was done until the ink stopped spraying or the case until one of the nozzles failed. Based on these observations we found the maximum spray duration before failure was 20us and the minimum was 3 us. No noticeable changers were observed in the pulse width for which remained constant ranging from 3 µs to 25 µs.

In the second instant the voltage was varied from 19v down and the pulse width was held at 5 us. Similarly we found that the maximum voltage before failure was 27v and the minimum voltage was 17.5v. No noticeable changes were observed in the droplet size which remained same between 17.5v to 27v.
9. Result
Printer requires approximately 2 second to print on line of an A4 size paper. It is capable of printing alphanumeric characters as and when inputted. The below is an illustration of 96 dpi printing resolution.

![Fig: 5.Initial phase Printed text prototype model.](image)

10. Application
It can be used for any size of paper. Printing requirements can be fulfilled irrespective of location can be used for printing on any surface regardless of medium.

11. Scope
In order to provide printing accessibility, having a portable printer will be a great help which you carry with you, the same way as you do with your mobile. Suitable for any dimension of paper it can be used for printing any kind of documentation. There is room for improvement if we make use of software application for orientation of printing coordinates.

12. Conclusion
In this paper the aim was targeted at improving the physical complexity of conventional printers. We have worked on different design and various concepts to come up with a final diagram as shown above. The obtained finalized diagram is a portable system, that can print on any surface of paper irrespective of dimensions. Furthermore, the concept of making a mobile application was thought as a way to provide access to documentation that need to be printed. The coordinates where printing is to be done is supposed to be provided with the help of software algorithms where printing can be rendered. Implementation of the above system is supposed to fulfill printing requirements irrespective of location thereby increasing productivity of work.

References