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Mechatronic System for Automatic Ink Feeding Machine

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ABSTRACT : Offset printing is widely used commercial printing technique that is used to produce consistent and high quality printed materials at competitively lower prices. Thus in offset printing it is necessary that printing quality is maintained throughout the printing process. To maintain the printing quality the parameters such as ink viscosity, temperature, surroundings must be well maintained. Also the operating speed is an important factor in printing process. In conventional offset printing processes the ink is fed to the roller manually by the operator. This leads to wastage of ink as more ink is fed than required and also the ink continuously remains exposed to the atmosphere which affects the properties of the ink thereby affecting the print quality. Also the process requires constant ink feeding making it labour intensive as continuously it requires a operator. So to overcome above issues it is required that automatic ink dispensing system at cheaper prices should be installed for offset machines.

KEYWORDS : Offset printing ,Mechatronics , Automation , Ink feeding , Arduino , Printing , Ink

I. INTRODUCTION

Mechatronic systems for ink feeding in offset printing is a technology which is recently proving to be cost effective in the era of cut throat competitions nowadays. Basically, Ink dispersion technique is inspired from the Ink Agitators and has an edge over former technologies. The spontaneous characteristics of ink were the reason behind the development of this automated assembly setup. Thixotropy affecting the ink characteristics was real concern during the printing process. This was accompanied with several factors like varying ink viscosity, ink contamination, ink wastage due to excess ink remains in the duct and time consuming process due to manual operations and many more.

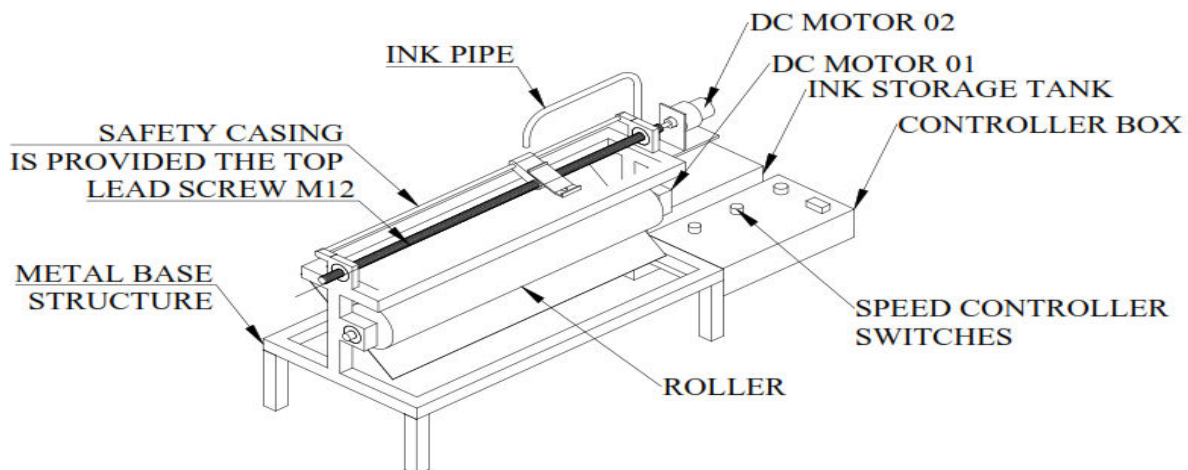


Fig.1 Prototype model



We are providing solution to ink feeding by fabrication of a prototype model as shown in figure above .The aim of this project is to get continuous drop of ink uniformly over blanket plate from one end to other .Then direction of motion of ink carriage gets reverse so as to perform reciprocating motion of ink carriage .This ink dropped on blanket plate is fed to roller set at specific rpm which will pass ink sheet of uniform thickness to further rollers engaged with it .

The main challenge here is thixotropic behaviour of ink which tends to change ink consistency and becomes more fluid as a result of working and less fluid on standing .This system keeps the entire quantity of the ink in working consistency by continuously stirring the ink and by providing only the necessary quantity to the nip between duct and roller which was previously wasted due to accumulation and due to exposure to atmosphere during the process of ink refilling.

The construction of prototype is shown in figure 1. Structure is mounted on base frame made from M.S. on which bearing houses are provided for roller and leadscrew .Leadscrew and roller are coupled with D.C motors .Here leadscrew is used for smooth reciprocating motion of ink carriage .Blanket plate is mounted inclined near roller with clearance for ink feeding .Ink is stored in tank enclosed from surrounding where continuous stirring is done by stirrer .This ink is pumped to carriage by DC pump.Motors are controlled with NANO Arduino programmed with C language .It includes various electronic components such as resistors,capacitors,motor drivers/controllers etc.Motor drivers are used to reverse direction of rotation of motor when limit switch is pressed .Speed of motors can be controlled by switches on control panel.

So when circuit is switched on motors are activated by Arduino and as a result leadscrew and roller starts rotating. A lock nut is fitted on leadscrew performs reciprocating motion due to threads cut on them .Suitable pitch is selected to get proper advancement. Simultaneously ink is pumped from tank to carriage and dropped on blanket plate.As carriage being mounted on nut ; it is moved from one end to other where it presses limit switch .It sends signal to Arduino and direction of motor gets reversed .Again it starts reaching towards starting end and this loop continues .In this way ink is dropped on blanket uniformly and consistently as and when required .

Hence it allows efficient ink management and wastage is avoided .As there is no wastage and manpower involved;overall cost is reduced .It takes comparatively less time than conventional manual ink feeding and promotes automation !

II. LITERATURE REVIEW

Printing is a process for mass reproducing text and image using a master form of template. There are different types of printing processes such as lithography, flexography, digital printing, screen printing, 3D printing, letterpress, gravure etc.[1] Out of all these the most widely used printing process is lithography. Offset lithography is a planographic printing process which requires an image carrier in the form of a plate on which photochemically produced image and non image areas are receptive to ink and water respectively.[2] These plates are then mounted on a cylinder and plate is dampened with chemical concentrates which adhere to non image areas. These plate when contacted with ink rollers the ink is only applied to image areas under pressure and image is transferred to the blanket through which it is transferred under pressure to a sheet of paper on which an image is to be produced.[3]

The above process goes easily from the theoretical point of view. But in practical there are many problems faced during the printing process. Out of which print rejection is a major concern in medium and large scale printing industries. One of the major reasons of print rejection is the lack of consistency and printed quality requirements which are affected due to different parameters. Several parameters such as ink viscosity, temperature, atmospheric exposure etc play an important role.[4] In conventional offset printing processes the ink is fed manually by the operator which leads to wastage of the ink due to excess ink fed to the roller than required. Also the ink duct remained open to the atmosphere thus leading to change in the characteristics of the ink over period of time. There was also a need of operator for continuous ink feeding to the roller for continuous operating. This also increases the labour required.

So to overcome the above mentioned drawbacks several new methods were employed. It includes simple systems to complex automatic dispensing machines. In one of the systems instead of ink feeding manually the ink roller was immersed into a tank full of ink. Thus the roller remained wetted throughout the process. But gradually the ink container gets heated up thus changing ink quality. In some other systems there were 4-5 nozzles continuously dropping ink over the roller to which ink is to be fed but this leads to accumulation of ink forming lumps. Also these

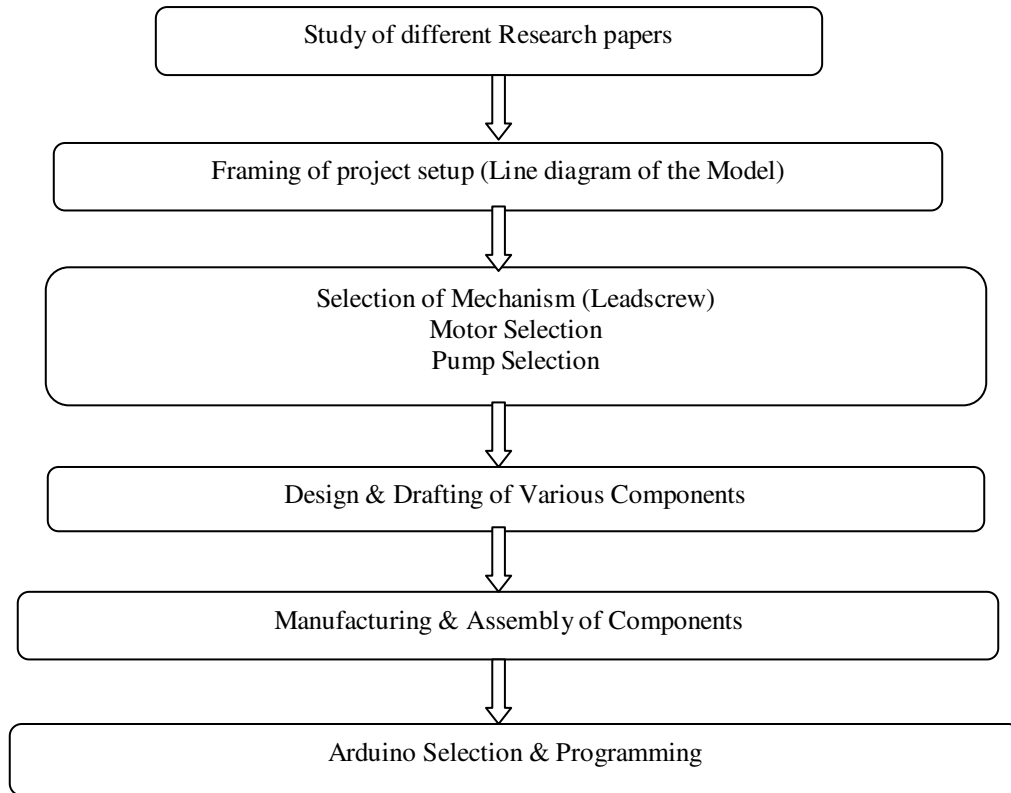


systems are costly in consideration to their motive. Hence to eliminate these problems there is need to develop an automatic system which will avoid ink wastage, maintain ink consistency and provide faster operating speed. So we need a mechatronic system consisting of electronic components such as arduino, actuators etc for quick and automatic operation and efficient mechanisms for uniform ink dispersion and required rigidity considerations and also taking into account cost considerations.

III.METHODOLOGY

We have started our work with literature review .After referring several papers , we got the idea of what our destination exactly is .After this we started design of our idea .Calculation of various design parameters of different parts in the prototype was done and model was designed .

The objective is to be achieved through the following steps which defines the methodology adopted in this project work:



IV. DESIGN & DRAFTING

Different components are designed according to stress analysis with selection of suitable material as follow.

1. Frame :
The Frame fabricated for our project which is made up of M.S. It is welded accordingly for arrangement of the system components.
2. Shaft Design :
The material used for design of shaft is EN-24. Since the loads on most shafts in connected machinery are not constant, it is necessary to make proper allowance for the harmful effects of load fluctuations. Keyway allowance is also considered due to reduction in strength .Then torsional shear stress is found to make design safe.[5]
3. Lead screw design :



Lead screw is the ultimate component that takes up the load that is to be lifted or lowered by lift. It also delivers torque from the motor to the nut and also prevents falling of the lift due to its own weight.

This will cause reciprocating motion of nut by changing drive.[5]

4. Design of nut :

The material of the nut is assumed to be mild steel .Assumed that load W is uniformly distributed over cross sectional area of nut .[5]As ink carriage is assembled to this nut,it will drop ink horizontally on the blanket plate.Ink towards carriage is supplied through pump.

5. Selection of bearing :

Spindle bearing will be subjected to purely medium radial loads;hence we shall use ball bearings for our application .

Selecting, Single row deep groove ball bearing (from catalogue). [5]

Here is orthographic and assembly drawings of model mainly done by using CAD. Furthermore it includes photograph of actual working prototype model made as a part of final year project of Mechanical Engineering.

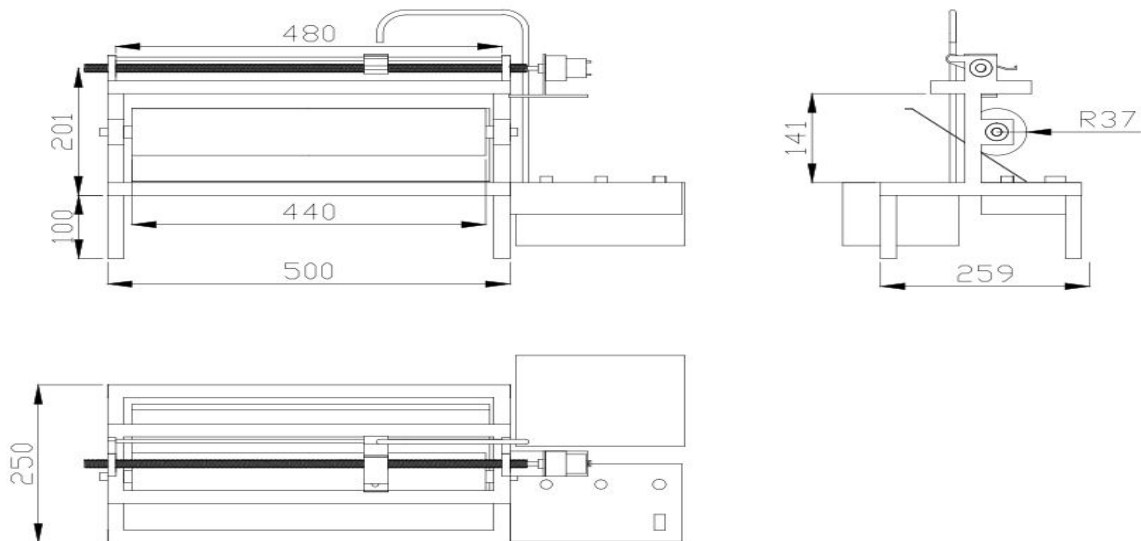


Fig.2 Drawing

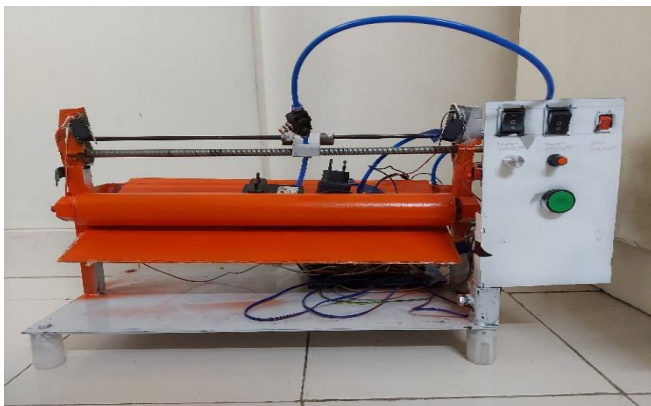


Fig.3 Drafting using CAD Software

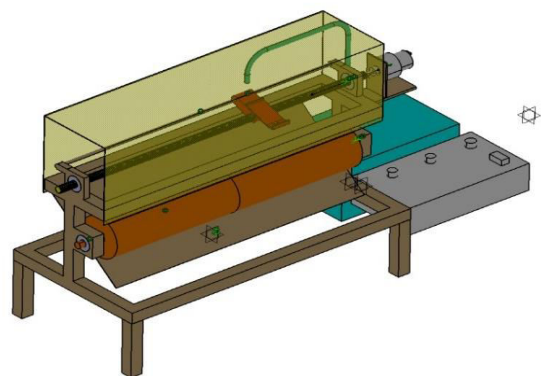


Fig.4 Actual Project setup



V. ELECTRONIC CIRCUIT

Arduino:

The Arduino is an open hardware microcontroller platform. It consists of a printed circuit board with a microcontroller and all the supporting hardware necessary to use the microcontroller mounted on it. All of the designs for the PCB (printed circuit board) layouts are freely available. A simple IDE (integrated development environment) has been created it uses a simplified version of C language, making it easier to program and many code libraries have been written. This has simplified working with microcontrollers, and has opened up the world of microcontrollers to people who would otherwise have been deterred by the complexity of working with them. [6]

The Arduino comes in many variations, and it is based either on an 8-bit Atmel AVR microcontroller or on a 32-bit Atmel ARM. [7] An Arduino will be used to control the motor drive. It is programmed such that ink carriage is driven by leadscrew mechanism from one end to other. Then direction of rotation of motor is reversed by controllers. Hence reciprocating motion is obtained. So Arduino will control pump motor, leadscrew motor & roller. The version used is the Arduino NANO based on the 8-bit Atmel ATMEGA328 microcontroller.

In this way mechanical and electronic disciplines are integrated which results in a mechatronic system for ink feeding.



Fig.5 Arduino NANO

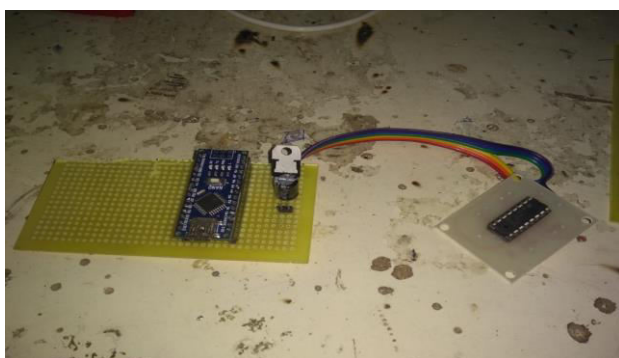


Fig.6 NANO Arduino with motor driver



Fig.7 Control panel



VI. APPLICATION

The soul application of this project is as an autonomous accessory for input of the ink for the Offset Printing machine.

VII. CONCLUSION

- The Ink dispersionUnit Project has been an ongoing research and development project in the past few years by the researchers that has consistently brought out new ideas for enhancement and/or replacement of existing inking system. Ink dispensing in the immediate future will become an integral part of sheet fed offset press and can be improved upon for increased efficiency, performance, and functionality to cope with the web offset printing machine.
- Ink Dispensing Technology could dramatically improve print quality acquisition, ink consistency and press speeds. It would also improve operational safety and also the jobs overall cost effectiveness. We believe that printing industry could immediately benefit from this technology. We hope the use of the control techniques developed for this Ink dispersion Unitwill contribute to the significant advancement of printing machine in the future.

VIII. ACKNOWLEDGEMENT

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