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Design and Development of Automatic Finger Inking Machine for Electoral Usage

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***Abstract*: The importance of finger inking can't be undermined in a dynamic election scenario where there is lack of trust in registration figures, number of voters. In India the electoral finger inking process is predominantly manual as on today where the left hand index finger of voter is inked with silver nitrate by another person hired for the job. It involves manual counting of voters usually by ticking a roll list of voters. This thesis involves development of automatic finger inking machine that inks the index finger and also displays the number of voters. The idea is to reduce the manual intervention in inking and counting at the poll booth. The machine automatically works based on human touch on the capacitive type sensor. The touch signal voltage triggers a motor drive unit which rotates, in turn driving the inking mechanism that holds the inking brush. Soon after the inking is done, a proximity type sensor counts the number of votes and the same is displayed on an electronic counter display. The machine and the mechanism used is simple and is very much suitable for mass production and is cost efficient too.**

Keywords— Finger Inking, Indian Election System, Gear; Microcontroller; Capacitive Touch Sensor,Proximity Sensor,CATIA V5.

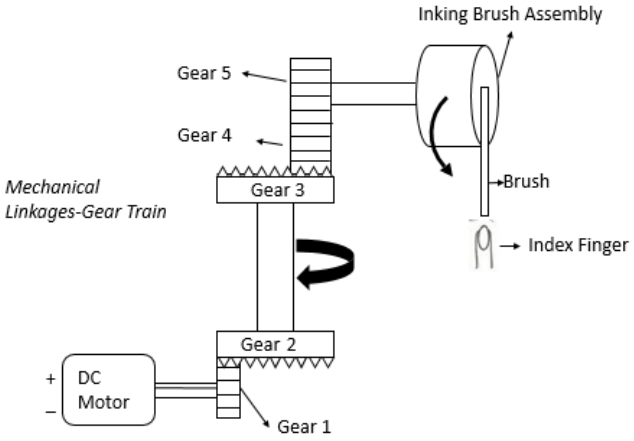
I. INTRODUCTION

The inking of voters' finger after casting their ballot is increasingly considered as an essential measure to prevent multiple voting especially in contexts where there is lack of trust in the registration figures and post conflict situations where on the Election Day registration of voters could be allowed. The ink must be enough to mark all potential voters and contain a specific mandatory quantity of silver nitrate to remain on voters' finger until polling operations are concluded. Electoral assistance is also very often an entry point for wider good governance.

This paper is presented for automation of finger inking process and counting the number of voters. A set of gear train driven by a motor is used to generate circular motion of the finger inking brush. Paper is focused on automation based on human touch. A set of gears as shown in the figure below is automatically driven by DC Motor which operates based on signal command from Microcontroller. Number of revolution of Motor is predefined by timing the input electrical signal to motor. The signal to microcontroller to start the cycle is given by output Voltage signal of the Touch sensor.

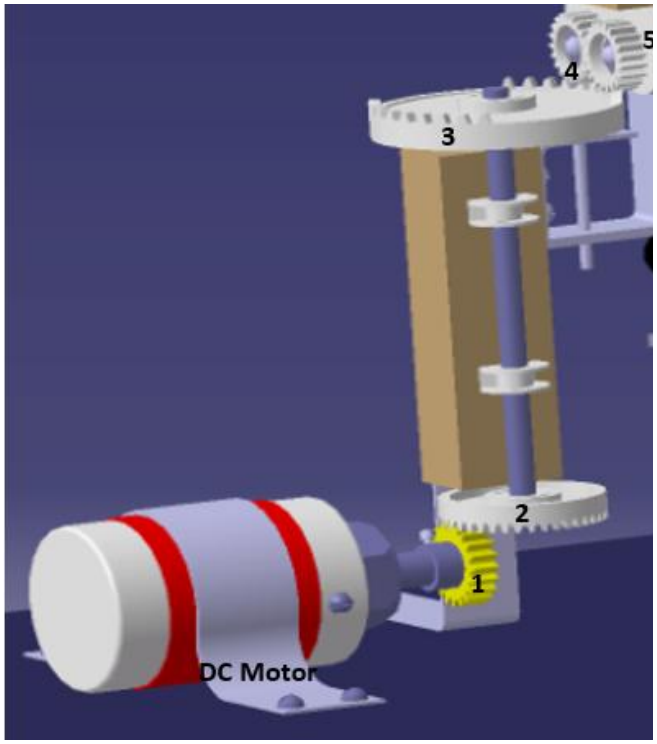
A. Working Principal- Gear Train:

Figure 1:Mechanical Linkages



Gear 1 is mounted on Drive Motor shaft. The Motor input Gear 1 drives Gear 2 mounted on a vertical shaft. Gear 2& Gear 3 will move at the same speed. Gear 3drives Gear 4,Gear 4 and Gear 5 are together and rotate in opposite direction with respect to one another. Gear 4 drives Gear 5.Gear 5 has inking brush assembly coupled on the other end of the shaft, rotating at the same speed. Inking Brush assembly as shown is a simple circular hollow cup that has Inking brush screwed .The rotation of Gear 5 rotates the entire inking assembly which in turn rotates the inking brush. Inking brush could be of refill type used in permanent markers or sketch pens or could be made like a ball pen where pressure releases ink. This paper does not concentrate on type of ink. The 3D model of the above gear linkages is developed in CATIA V5 – CAD tool.

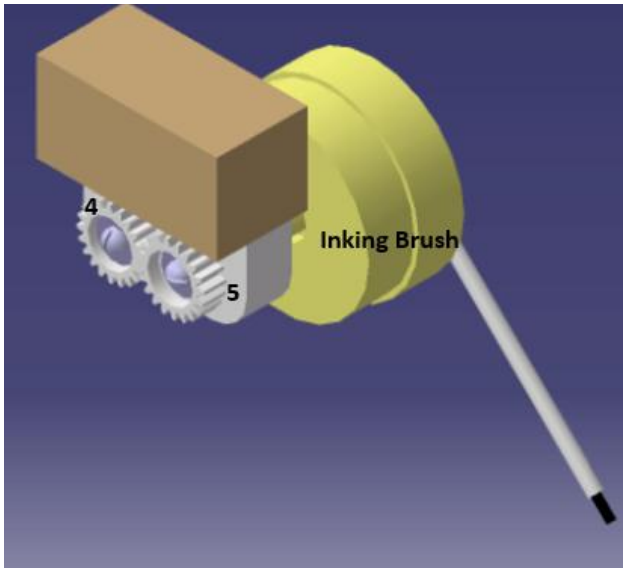
Figure 2:CAD Model of the gear train system developed In CATIA V5 CAD tool.



Inking Brush Assembly:

Revolution of the inking brush is final output of the gear train. Gear 4 takes the input from Gear 3. Gear 4 and Gear 5 rotate at the same speed. An inking brush is mounted on press fit shaft at the other end of Gear 5, hence revolving at the same speed as Gear 5. The isometric view below shows the assembly.

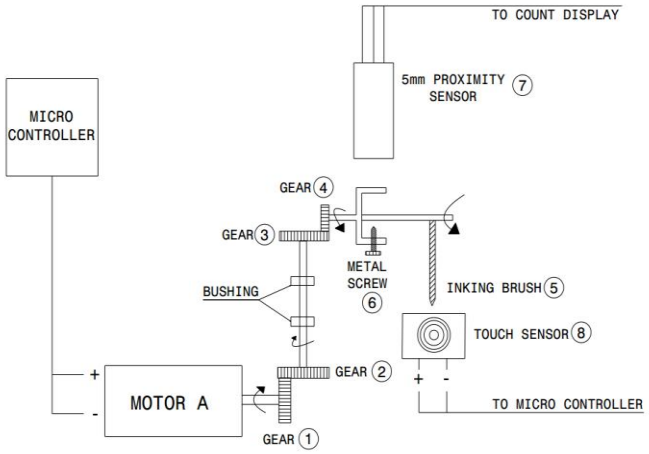
Figure 3:CAD Model of the Inking Brush Assembly developed in CATIA V5 CAD tool.



B. Automation of Gear Train:

A Capacitive Touch Sensor is placed at the inking platform. Human touch sends control signal to Micro Controller (PIC16F886). Micro controller is programmed to send electrical power to drive motor when it receives signal from Touch sensor. In this case DC motor (12V, 10 rpm) is switched on via current amplifier. DC motor in turn drives the gear train. Inking brush assembly hasmetal screw within proximity distance of less than 5 mm of the proximity sensor surface. Every revolution of the Inking Brush is counted as 1 vote count and is displayed on a 20x4 LCD Screen.A Schematic diagram below explains the working of the assembly with respect to the programmed automation.

Figure 4:Schematic Diagram of Assembly showing gear train and electronic components for automation



The sequence of control signals are:

1. Output Voltage Signal from capacitive touch sensor to Microcontroller
2. Electrical signal from microcontroller to DC motor via Current amplifier.
3. Proximity sensor output signal to LCD Display to display count, via Microcontroller

II. DETAIL DESIGN

A. Gear Train Design:

Table below has details of five gears that are used to achieve the desired number of revolutions of the inking brush.

Gear Details		
Gear	Circular Pitch	Number of Teeth(T)
Gear 1. : Drive Gear	2.5 mm	T1=20
Gear 2: Driven Gear	3 mm	T2=40
Gear 3: Drive Gear	4 mm	T3=40
Gear 4: Driven Gear	4 mm	T4=20
Gear 5 : Driven Gear	4 mm	T5=20

Material: Standard Plastic Gears are used.
Gear Ratio Calculation:
The below gear ratio calculation explain the speed ratio between the Gear 1 & Gear 5. Substituting values from the table above;

$$\frac{T1}{T2} = \frac{20}{40} = \frac{1}{2}$$

$$T2 = T3 = 40$$

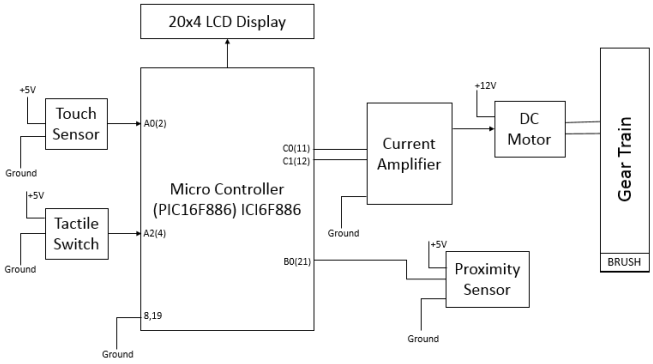
$$\frac{T3}{T4} = \frac{40}{20} = 2$$

$$T4 = T5 = 20$$

$$\frac{T1}{T2} * \frac{T3}{T4} = 1$$

$$T1 = T4 = T5$$

Figure 6: Schematic Diagram of the Electronic Circuit



The above diagram shows various components critical to automation of the gear train. The core of the automation is the Micro Controller, which is programmed to receive specific inputs from touch sensor, proximity sensor and send out specific output signals accordingly.

EEPROM is used to write program for sequence of activities listed below:

a. Receive signal from Capacitive Touch Sensor
b. Switch on power supply for DC Motor via current amplifier
c. Receive input from Proximity sensor
d. Calculate Voter count, increase by one after each cycle
e. Send output signal to display the count on LCD Screen

Reset button: Reset button is provided on the microcontroller unit to erase previous counts and start from zero count.

III. SPECIFICATIONS OF KEY ELECTRONICCOMPONENTS

SL Number	Component Description	Component Specifications
1	Touch Sensor	5V, Capacitive Touch
2	Current Amplifier	(ULN2003)
3	DC Motor	12V, 10 RPM
4	Proximity Sensor	5V , 5mm
5	Tactile Switch	5V
6	Micro Controller	(PIC16F886)
7	Battery Power	12V,DC
8	Regulator	(7085)
9	Reli-mate Connector	2pin, 3pin, 4 pin Male
10	Potentiometer	10k
11	LCD	20x4 character display

IV. RESULTS

It can be seen from the Gear ratio calculation that every revolution of the drive gear G1 results in one revolution of the final driven gear G5. Gear 5 has inking brush assembly coupled with screw at the other end of the shaft.

Micro controller is so programmed that one touch on the capacitive touch sensor will result in one revolution of Gear 1.

V. CONCLUSION

Automation of finger inking is successfully achieved by the above mechanism. This can be successfully used in Indian election scenario where index finger is inked to prevent double voting. It can also be noted that the micro controller can be programmed for timing based inking or instance based inking. The machine can be fairly simple and easy to use.

VI. ADVANTAGES

a. Easy/Suitable for mass production
b. Compact and Portabile
c. Cost effective
d. Easy to operate, no maintenance required

VII. APPLICATIONS

a. Finger inking in Indian Election System
b. Storage & Warehousing
c. Alternative marking/ticketing mechanism for Amusement parks, Movies, Disc, and other mass gatherings
d. Inking children in Polio drives

FUTURE WORK

Integration of bar code reader to read UID (Unique Identity number provided by Unique Identification Authority of India) card Number, AADHAR card.

Development of Voting Kiosk to integrate voting activities Such as automatic inking, e-reading of voter identity and details, finger print recognition, other biometric data verification, and voting.

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