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DESIGN AND FABRICATION OF AUTOMATIC LIQUID FILLING MACHINE

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Abstract*- This paper proposes a system based on automation. Nowadays almost all industries are going through automation. In present world it is a big challenge, how to minimize production time and how we can get final product more efficiently. As a result we are thinking about automation process. This project is based on automatic liquid filling machine, is a process of automation also. Proper weight of liquid will be maintained in this project. Not only this but also number of filled jars will be shown on LCD display. After completion of all jars automation process will be stopped and need to replace empty jar for further filling. This automation process will be programmed in a microcontroller. Pressure head of liquid will be used for filling empty jars. Empty jars are filled one by one by proper angle maintained by Stepping motor and solenoid valve timing. IR sensor is used for confirmation of arrival of empty jars. In industry for doing this job fewer workers is needed and monotony for work can be removed. Nowadays automation for filling liquid is frequently used in almost all industry especially in juice, oil, mineral water, petroleum, coke industries and others. It is just a part of full production process. After filling automatic sealing can be done. But it is not concern of this project.*
The concern is only on "Design and Fabrication of Automatic liquid filling machine" It will be more economic and ergonomic design for mass production.
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Keywords: Automation, microcontroller, solenoid valve, Stepping motor, IR sensor

1. INTRODUCTION

Automation is the use of control systems such as numerical control, programmable logic and other industrial control systems. Automation plays an increasingly important role in the world economy and in daily experience. Automation has had a notable impact in a wide range of industries beyond manufacturing. Nowadays almost all industries are going under automation process. For present demand an automation based project is selected. Project title is "Design and fabrication of automatic liquid filling machine". It will reduce human effort. In this project automation process of filling liquid bears less cost and filling liquid will be done more efficiently.

2. ADVANTAGES & APPLICATION

Such Automation based project carries following advantages -
   1. Less space required.
   2. One operator for both operation i.e. filing & sealing.
   3. Low cost.
   4. Low consumption of power.
   5. Time saving.

It is necessary for industrial purposes. For specific amount of liquid it will be required. This automation process is maintained in Oil producing factory, mineral water, coke, petroleum oil, various juices making factory & almost in all industries. This process helps us to do work in short time & efficiently. It also retards monotony for doing same work. Overall it makes our life easy.

3. WORKING PRINCIPLE

In this project small jar has been filled automatically one by one. Proper weight of liquid has been maintained. For filling liquid a solenoid valve has been needed. It has maintained the accuracy of Bottle filling. As liquid level has been decreasing gradually, flow rate also decreasing. It has been needed more time to fill next jars. Time also has been increased gradually one after another. To eliminate this problem it has been considered trial and error process. At first a jar has been taken which was labeled and a container to hold liquid. Pressure head of this liquid has been used as energy to fill jars. Let at first liquid level was h_1, then started to fill jar and when finished one jar liquid level has been decreased to h_2. Flow rate has also been decreased as a result of decreasing height. Now it has been needed more time to fill the next jar than previous one. This time has been adjusted by delay time of solenoid. This program is governed by micro C++.Relation between time and head
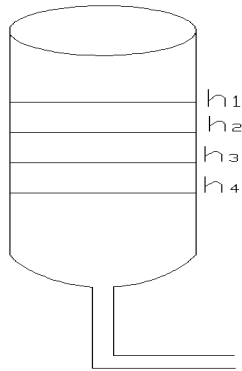
is shown in below figure no 1.

Fig.1: Relation between time and head.

$$h_1>h_2>h_3 \text{ (Height)}$$
$$t_1<t_2<t_3 \quad \text{(Time)}$$

Not only this but also number of filled jars have been shown on LCD display. When all of jars have been filled, Automation process has been stopped. Then it has been needed to replace new jars. Whole setup for this project is shown in below figure no 2 and figure no 3 shows filling process one after another with motor rotation.
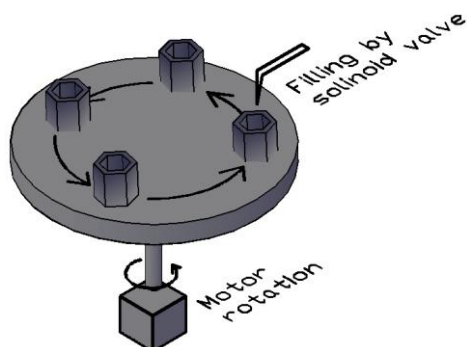

Fig.2: Whole setup of Liquid Filling Machine

Fig.3: Filling Process.

4. MAIN COMPONENTS

Hardwires which are used in this project are described below in brief.

- ❖ Infrared sensor
- ❖ Stepper motor
- ❖ Microcontroller
- ❖ LED
- ❖ Resistor
- ❖ Capacitor
- ❖ Relay
- ❖ Transistor (BD-135)
- ❖ Op-amp(LM 324)
- ❖ Voltage regulator(7805)
- ❖ LCD
- ❖ Solenoid valve

In this project IR sensor is used to detect arrival of empty jars. Variable resistance for adjust frequency. Relay switch is used for operating solenoid valve, Voltage regulator for supply +5 Volts to Microcontroller. Stepping motor which is used in this project has operating voltage is 12 Volt. It rotates 1.8 degree per step. Here solenoid valve is an electromechanical device which allows for an electrical device to control the flow of liquid.[2]

5. FLOW CHART

Working procedure of liquid Filling Machine has been shown by flow chart in below figure no 4. After receiving signal from IR filling started in specific amount. After filling one jar LCD shows counting 1. Filling is controlled by timing of solenoid Valve as well as Motor rotation. After completing all jars two messages are shown on LCD. Then system is idle to remove filled jars. After that with pressing switch system is started to fill Liquid. By this system production of all days is easily measured.
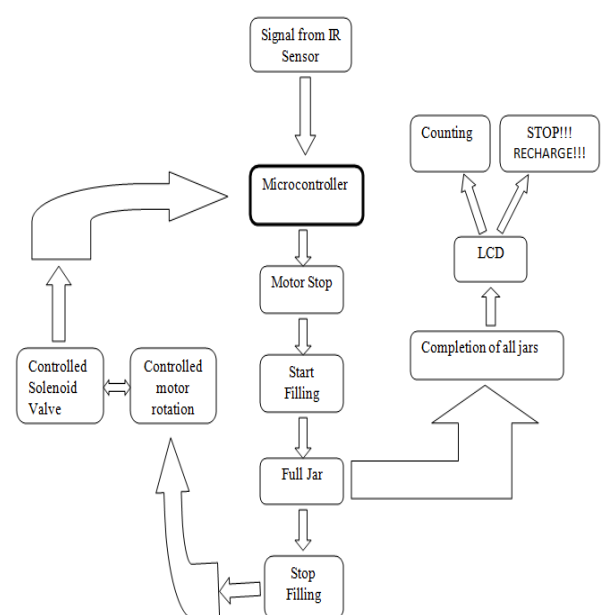

Fig.4: Flow chart of Liquid Filling Machine

6. CIRCUIT DIAGRAM

For this project PIC 16F72A has been used. Port C has been used for Motor and pins are C_4, C_5, C_6, C_8. Port B has been used for LCD and pin numbers are B_4, B_5, B_6, B_7. Pin C_0 has been used for sensor which is connected to Operational Amplifier. Circuit diagram has been shown below figure no 5.
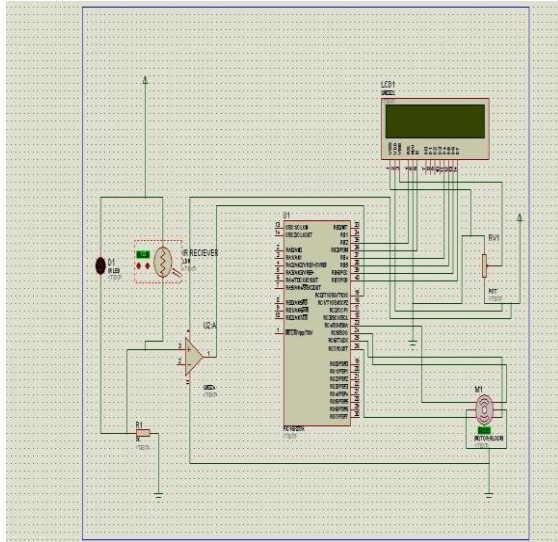

Fig.5: Circuit Diagram of Liquid Filling Machine

7. GOVERNING EQUATION

The governing equation of this project is given in Eq^n no 1. Relevant figure is shown in fig no 1[1]

$$Q = AV = A\sqrt{2gh} \quad\text{......... (1)}$$

Here, Q = Flow rate
  V = Velocity
  h = height of liquid

8. RESULTS AND DISCUSSION

This project is based on automation named "Design And Fabrication of Automatic Liquid Filling Machine". Objective of this project was to fill liquid in specific quantity and to count down number of filled jars. This project has been worked properly according to objectives. When any one of jars have come close to IR sensor it has detected arrival of empty jars and motor has been stopped to fill liquid. After finishing one jar, counting 1 has been shown on LCD Display and Motor has been started. Filling of Liquid has been controlled by delay time of solenoid valve. When all jars have been filled a message "Stop!!! Recharge" has been shown on LCD Display. Not only these but also total Production of a day has been shown on LCD Display.

The research and analysis performed for this project has invented a new door in the field of Automatic Liquid Filling Machine. The results and findings of the project mostly correspond to the main hypothesis. In this project circuit design has made as simple as possible which has given the required functionality. The step by step testing and troubleshooting approaches has been followed. The circuit has been worked without any errors. The circuit has made flexible and portable solutions, useful for a wide range of applications.

9. CONCLUSION

Present world is a time of automation. On the wing of automation we can improve manufacturing process. Nowadays daily life is getting the benefits of automation process. Almost all industries are going through automation process. Governing chip of this project is PIC 16F72. As PIC 16F72 is easily programmable, program can be changed anytime to fulfill our objectives. It will reduce human effort and it is more economic. This automation process is time saving also and power consumption is less. This automation process is being used in coke, juice, pure water, oil, paint, milk, Petroleum oil and many other industries. But this work will be done more efficiently with my project. I think this project will enrich the automation system to fill empty jar.

10. ACKOWLEDGEMENT

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11. REFERENCES

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12. NOMENCLATURE

Symbol	Meaning	Unit
Q	Flow rate	(m^3/s)
V	Velocity	(m/s)
h	height of liquid	(m)
A	Area of Nozzle	(m^2)
g	Gravitational acceleration	(m^2/s)