Automation For Pulp Mixing In Paper Industries

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Abstract: Many of the process technologies in today's paper industry have been established few years ago. Measurement of moisture content in paper pulp is the main objective to improve the quality of the paper. In paper industry the paper and water are mixed together in a digester tank. In processing section obtained pulp is sent to a dryer to remove the water content in the paper. And finally to a paper cutting machine. Measuring of water content in paper pulp is one of the main problem in paper industries. All the existing methods for measuring the water content in paper have few drawbacks as time requirement, not suitable for continuous process, labor involvement and are cost expensive. To overcome this problem a low cost device is proposed to automate the mixing of water in the paper pulp. The proposed hardware consists of moisture sensor, arduino board, LCD display, pH meter and a temperature sensor.

Index Terms: paper pulp, water level, moisture sensor, pH level, temperature sensor.

1 INTRODUCTION

Paper is a type of thin material manufactured by pressing the moist fibres of cellulose pulp from wood, paper chips and drying them into flexible sheets. It is a flexible material with many uses like writing, packing, cleaning, decorating and construction process. Papers are essential in legal and non-legal documentation.Modern paper plants produce over 1000 metric tons of paper per day on a single production line. In paper making factories paper is made by continuous mixing of paper and water in a digester tank. And the obtained paper pulp is taken to a drier section to remove the heat in the paper, and then to a roller. And finally to a paper cutting machine. Measuring of water content in paper pulp is one of the main problem in paper industries. In industrial production the water content in material pulp is always a very important process parameter.To overcome this problem a low cost device is proposed to automate the mixing of water to the paper pulp. The proposed hardware consists of moisture sensor, arduino board, LCD display, pH meter and a temperature sensor.

2 OBJECTIVES

The main objectives of this project are as follows:

1. The quality of the paper is maintained even at all the sides
2. The mixing of paper pulp and water is automated by using moisture sensor.

3 METHODOLOGY

In the proposed system, checking of water content is automated at the slanting path block in figure 4.1 this is carried out by using a moisture sensor, pH sensor, temperature sensor, arduino board, a LCD display and a buzzer.

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3.1 PROCESS DESCRIPTION

In the paper industry the paper is made by different production process. Figure 1 shows the block diagram of production process. It consists of several sections such as input section, digester section, heating section, roller section and a finally assembly section. The paper material in various forms such as paper cup, plastic cup, paper roll, paper plate etc., enter into the digester tank on a continuous bases. By a slanting path the paper material which is given as input is taken to another digester tank where water is added separately the same digester through another pump. The paper and water is well grinded and mixed in the second digester and it will be in the form of a semi solid state. Some pressure is applied to the pulp to extract the water content present in the paper pulp. Then it is passed on to a roller section where heat is applied to remove the remaining water content. Finally the dry paper is passed to a roller where the paper pulp is rolled over continuously and the paper is continuously dried off. Then the paper is sent to the assembly section where post production takes place such as cutting of paper into required size and packaging of paper is done.

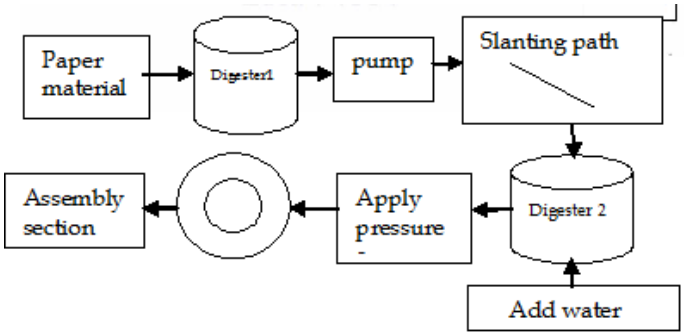

Figure 1 *Block diagram of process*

4 DESIGN OF COMPONENTS

The automatic water indication system proposed in this paper, is made by the following list of components

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4.1 MEASURING OF MOISTURE LEVEL IN PULP CONTENT

As shown in figure 1 two moisture sensors are fitted at both the ends of the slanting path which is connected between the

first digester and the second digester. The pulp content present at the starting of the slanting path will be solid whereas the pulp content at the end of the slanting path will be semi-solid. The moisture sensor at both ends measure the moisture (water) content present in the pulp which is flowing continuously in the slanting path.

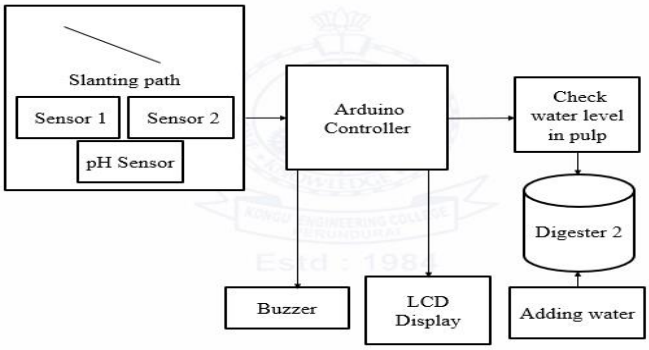

Figure 2 *Block diagram of proposed system*

Arduino Uno is interfaced along with the moisture sensor. On obtaining the water level (in percentage) of the pulp content at both the ends , the average (in percentage) of the water level from moisture sensor one and moisture sensor two is calculated. This process continues, and the average is calculated for 5 minutes and reading is noted for every 5 seconds. And according to the average obtained, if the water level (in percentage) is low than the appropriate level, the amount of water to be added is displayed in the LCD display and along with it a buzzer beeps. And if the water level (in percentage) is high than the appropriate level, then the amount of water present is displayed on the LCD display.

Compensation calculation for amount of water to be added

Example 1

Value of good pulp=80%

Value from sensor 1=87%

Value from sensor 2=67%

Sensor 1 is 7% greater than good pulp and sensor 2 is 13% less than the good pulp.

Compensation calculation=67%+7%

=74%

Hence 80%-74%=6% of water should be added. In 5 minutes the digester is filled with 500 litres of pulp so 6% of 500 is 30. So 30 litres of water should be added.

4.2 pH MEASUREMENT OF THE PULP CONTENT

As shown in figure 2 the pH is placed in the slanting path. The pH sensor continuously measures the pH level present in the paper pulp. And the pH value is displayed in the LCD display. If the pH level of the pulp exceeds more than the value 7 and drops below 5 a buzzer beeps.

4.3 TEMPERATURE MEASUREMENT OF PAPER AFTER DRY SECTION

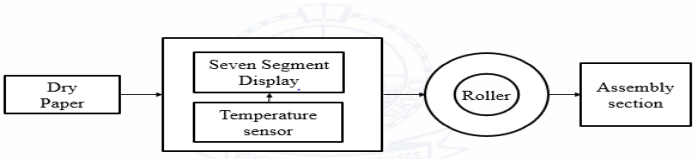

Figure 3 *Measurement of temperature of paper after dry section*

After the mixing of paper pulp and water in a digester, the pulp content is sent to a drier section, where the water content in the pulp is removed in the drying process. And the dry paper is sent to a roller where the paper is continuously rolled as shown in figure 3 Before the roller temperature sensor is fixed, where the temperature sensor consists of a 7 segment display. The temperature sensor measures the amount of heat present in the paper and displays it in the 7 segment.

5 RESULT AND DISCUSSION

The figure 4 shows the complete setup of the hardware connection which consists of two moisture sensors, pH sensors, a LCD display and two buzzers.

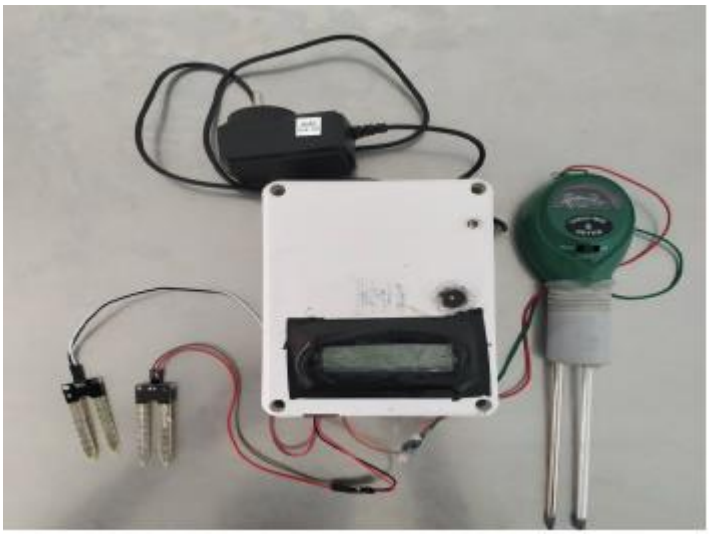

Figure 4 *Hardware setup*

5.1 RESULT FOR ADDING WATER

Table 1 *Continuous measurement of moisture and pH in pulp for every 5 seconds in time interval of every 5 minutes.*

Time (s)	Moisture sensor 1 (%)	Moisture sensor 2 (%)	pH value
5	84	72	6.11
10	84	75	6.09
15	85	73	6.10
20	86	72	6.11
25	84	72	6.11
30	87	70	6.11
35	85	69	6.10
40	84	70	6.09
45	85	68	6.09
50	82	66	6.10
55	81	65	6.10
60	86	71	6.11
65	84	70	6.12
70	85	68	6.12
75	87	66	6.11
80	88	65	6.10
85	85	66	6.12
90	80	66	6.08
95	89	68	6.11
100	85	71	6.11
105	85	70	6.12
110	84	68	6.13
115	86	67	6.11

120	89	67	6.12
125	89	69	6.10
130	91	71	6.10
135	88	70	6.11
140	85	73	6.11
145	85	74	6.11
150	85	71	6.11
155	84	70	6.12
160	84	68	6.12
165	83	69	6.11
170	85	67	6.10
175	82	68	6.11
180	83	68	6.12
185	86	69	6.13
190	87	72	6.12
195	86	73	6.12
200	85	65	6.11
205	88	64	6.10
210	85	63	6.09
215	84	65	6.09
220	81	67	6.08
225	80	67	6.09
230	88	68	6.10
235	80	69	6.11
240	83	71	6.11
245	89	70	6.12
250	87	72	6.11
255	88	69	6.10
260	79	68	6.09
265	78	71	6.09
270	80	71	6.10
275	81	73	6.10
280	79	75	6.10
285	82	72	6.11
290	83	71	6.11
295	84	70	6.10
300	82	68	6.11

Figure 5 *Hardware output for adding water*

5.2 RESULT FOR NO WATER NEEDED

Table 1 *Continuous measurement of moisture and pH in pulp for every 5 seconds in time interval of every 5 minutes.*

Time (s)	Moisture	Moisture	pH value
	sensor 1 (%)	sensor 2 (%)	
5	88	77	6.21
10	86	76	6.19
15	86	75	6.19
20	85	76	6.18
25	85	76	6.18
30	85	74	6.19
35	84	75	6.19
40	82	73	6.20
45	86	75	6.21
50	86	74	6.21
55	87	74	6.21
60	87	75	6.21
65	87	75	6.19
70	88	76	6.18
75	89	77	6.18
80	90	78	6.18
85	91	76	6.17
90	91	75	6.18
95	92	75	6.18
100	89	75	6.19
105	88	74	6.20
110	88	73	6.20
115	87	75	6.21
120	85	76	6.22
125	88	77	6.22
130	88	77	6.21
135	87	77	6.20
140	85	78	6.19
145	85	76	6.19
150	84	75	6.20
155	83	74	6.21
160	87	73	6.21
165	86	74	6.21
170	89	75	6.19
175	89	75	6.18
180	88	78	6.18
185	87	76	6.17
190	87	74	6.15
195	84	75	6.19
200	88	75	6.22
205	88	73	6.23
210	86	78	6.22
215	87	78	6.19
220	88	75	6.18
230	85	75	6.22
235	85	75	6.23
240	86	74	6.24
245	87	75	6.24
250	88	76	6.22
255	87	77	6.21
260	86	76	6.19
265	85	76	6.20
270	86	78	6.19
275	86	77	6.18
280	85	75	6.19
285	84	74	6.20
290	85	76	6.21
295	84	77	6.22
300	84	77	6.21

Figure 6 *hardware output for no water needed*

6 CONCLUSION

The proposed method calculates the amount of water to be added during the mixing of paper pulp and water in paper industry. Different samples have been taken and the experiments have been performed. The obtained results shows the effectiveness of moisture sensor in finding the water content in any pulp content. The entire setup is compact and simple. It can be implemented anywhere in industries.

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