Design and fabrication of a Security System, for a milk beverage dispensing system

Project report 2002 - 2003

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF **BACHELOR OF ENGINEERING IN MECHATRONICS ENGINEERING** OF THE BHARATHIAR UNIVERSITY.

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BONAFIDE CERTIFICATE

This is to certify that the project report titled

"DESIGN AND FABRICATION OF A SECURITY SYSTEM, FOR A MILK BEVERAGE DISPENSING SYSTEM"

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This report is submitted in partial fulfillment of the requirements for the award of the **DEGREE OF BACHELOR OF ENGINEERING IN MECHATRONICS ENGINEERING** of the Bharathiar University.

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We thank our **Almighty god** for being with us and guiding us to complete this project successfully.

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COMPANY PROFILE

ABT INDUSTRIES LTD, is part of 1200 crore SAKTHI group of companies. SAKTHI group is engaged in diverse activities in the field of sugar, dairy, textiles, finance, foundry, transport, industrial GEM manufacturing, dealership for leading brands of consumer durables and education. Among the first ventures of the group in the field of agro products was SAKTHI sugars limited.

Since its genesis in 1931, SAKTHI group of companies has grown to emerge as one of the most powerful agro based industries in south India. Over the years the company has been able to constitute an extensive network of more than 10000 farmers and other agro professionals to aid its production capabilities. ABT foods was specifically founded to capitalize on the ever-growing agro based industry. The product range of ABT foods is marketed under the brand name of "SAKTHI" and is known for its

"Quality, reasonable pricing and easy availability".

Dairy has been one of the successful endeavors of ABT foods. SAKTHI milk is already a household name in a large number of areas in south India. The companies manufacturing and processing facilities ensure that the milk retain its freshness from cow to customer. SAKTHI ghee has been successfully launched by the company. Other dairy products from ABT foods include flavored milk, butter milk, curd and panneer. The company is also in the process of bringing out other dairy products in the mere future.

SYNOPSIS

Our project is all about designing and fabricating a security system for a milk beverage dispensing machine, to prevent adulteration.

We aim at a security system, which is 100% foolproof. To provide such a system we have designed a container, which is used to hold the milk. This container replaces the milk packets, which are presently used for holding milk. This container is secured such that the middle men and the end users do not open it. Moreover, we call it as charging container.

The present container used for holding milk is modified, so that it is completely sealed and no one can open it without breaking. Moreover, we call it as mother container.

The milk can be transferred from the charging container to the mother container by placing the charging container over the mother container, which is assisted by electronic means.

We have also designed a circuit, which will indicate whether the milk inside the mother container is contaminated or not, by using a pH sensor.

Another additional feature we have designed is an electronic flow control valve used for dispensing five different quantities.

CONTENTS

1. INTRODUCTION

1.1. Existing machine

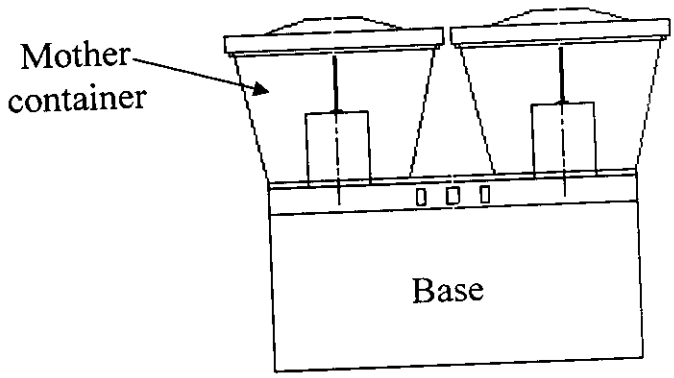


Figure 1a. Existing machine

The machine shown in fig 1a is manufactured by Dairy Den limited, Gujarat. It is counter top, visual display cooler and dispenser. It is designed to cool and dispense multi flavour products including synthetic syrup drinks, fresh juices, health drinks and flavoured natural/artificial milk drinks.

For day to day use, the milk should be filled in the container (bowl) by opening the cover of the container. Therefore, there is a possibility of adulteration by middle men. So the company people felt that quality of their milk might be spoilt. And that's why they asked us to provide security to that machine wherein the employee cannot involve in any kind of malpractices for his own benefits.

The milk is maintained within a temperature range of 5° - 10°C with the help of a thermostat, compressor and a refrigeration circuit.

The milk is kept in dynamic motion by a stirrer, which is rotated by a 0.25hp synchronous motor at 30rpm.

The container has to be cleaned, after daily use, since it is holding milk and it might contain bacterial agents. And for this the cover of the container, stirrer and then the container itself has to be removed from their original seating in order preceded by the cover then the stirrer and finally the container. Then the assembly should in the reverse order.

The container is made up of acrylic (poly methyl meth acrylate (PMMA)) and stainless steel sheets fabricated to have a good aesthetic appeal.

The present machine has manual control over dispensing the milk and finding out whether the milk is contaminated or not.

1.2 Objective of the project

Our objective is to provide hundred percent security to the machine without affecting its performance and aesthetic appeal. And to enhance the features of the machine to a stage where it can indicate the state of milk inside the bowl, it will indicate whether the milk is contaminated or not. And also to provide a facility wherein we can adjust the quantity of milk being dispensed in finite terms. And to do our project to the fullest satisfaction of our guide, company people and ourselves.

1.3 Our approach

We are going to seal the existing bowl (container) with acrylic sheet with a shape and size similar to that of the cover. And a hole will be drilled at the center of the sheet for the stirrer to rotate freely inside the hole. And also the stirrer will come out along with bowl when it is taken out for cleaning. The stirrer will actually be split into two parts. One will be having its seat over a slot in the shaft coupled to the motor. And the bowl will be cleaned with the help of large hole present at the bottom of the bowl. A gasket will be placed around the circumference of that hole and forced over the cylinder, which is used to cool the milk (part of refrigeration system present in the existing machine).

The milk will be stored in a container, which cannot be opened by the intermediators and the end users. This container called as charging container will replace the milk packets, which are used presently. And this container can be reused. This container can be opened in the industry where the charging container is opened, cleaned and refilled with milk. The container is provided with an electronic lock wherein it is opened by pressing a four-digit code.

The milk is transmitted from charging to mother container by placing the charging container over the mother container and both the containers open simultaneously. Each one acts as lock and key to each other. Two 2/2 way direction control solenoid valves placed in each containers controlled by a dedicated electronic circuit

placed in the mother container does the job for us. This concept is similar to that of electronic lock and key used in modern cars.

As an additional feature, we have used a pH sensor assisted by a dedicated electronic circuit to indicate whether the milk is contaminated or not. This is designed to ensure good milk reaches the customers. We have also designed a dedicated electronic circuit to control a 2/2 way direction control solenoid valve to dispense finite, different quantities of milk (say 50, 100, 150,200 and 250ml).

2. MODULES OF THE PROJECT

2.1 Mother container

2.1.1 Existing container

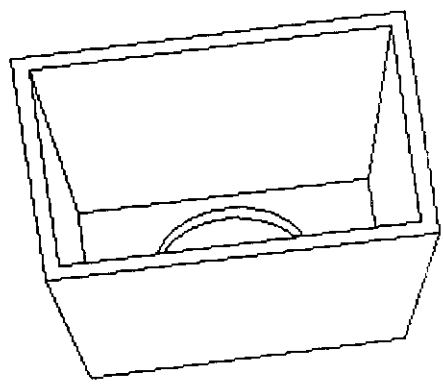


Figure. 2a Existing container

2.1.2 Modified container

A part has been made of acrylic sheet in shape and size similar to the cover of the existing container and it is pasted over the

present container. Two holes are drilled on top of the sheet as shown in figure.2b (left), one for a mating part (we call it as female mating part) and other for the rod of stirrer that is to be passed through that hole with a head, so that it can be hanged there. And note that the stirrer can rotate freely. The mating part and the stirrer will be discussed in later chapters. Look for appendix d for dimensional diagrams.

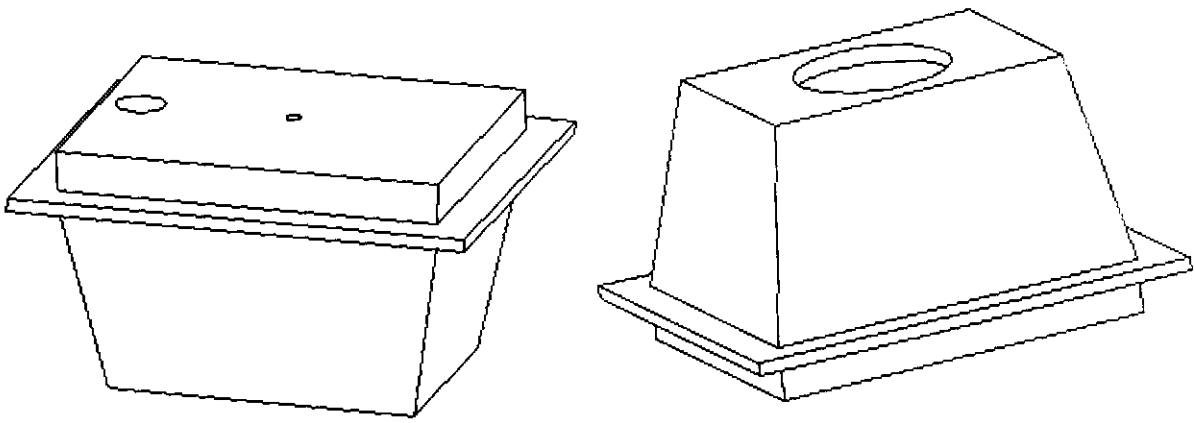


Figure.2b views of modified container

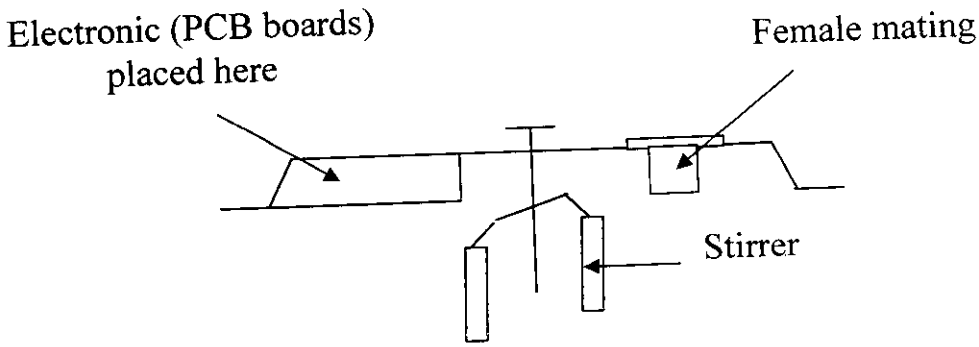


Figure.2c line diagram of cover

2.2 Charging container

2.2.1 About the container

We have made this container out of aluminium sheets. And this just a model of the container. And we suggest acrylic or fiber glass, if this concept is commercialized. The reason being it is possible to mould (injection moulding) the container with either acrylic or fiber glass. Therefore the level of accuracy and aesthetic value of the container will be high. And there will be no leakage. And we can avoid the use of polythene covers (packets) for holding milk.

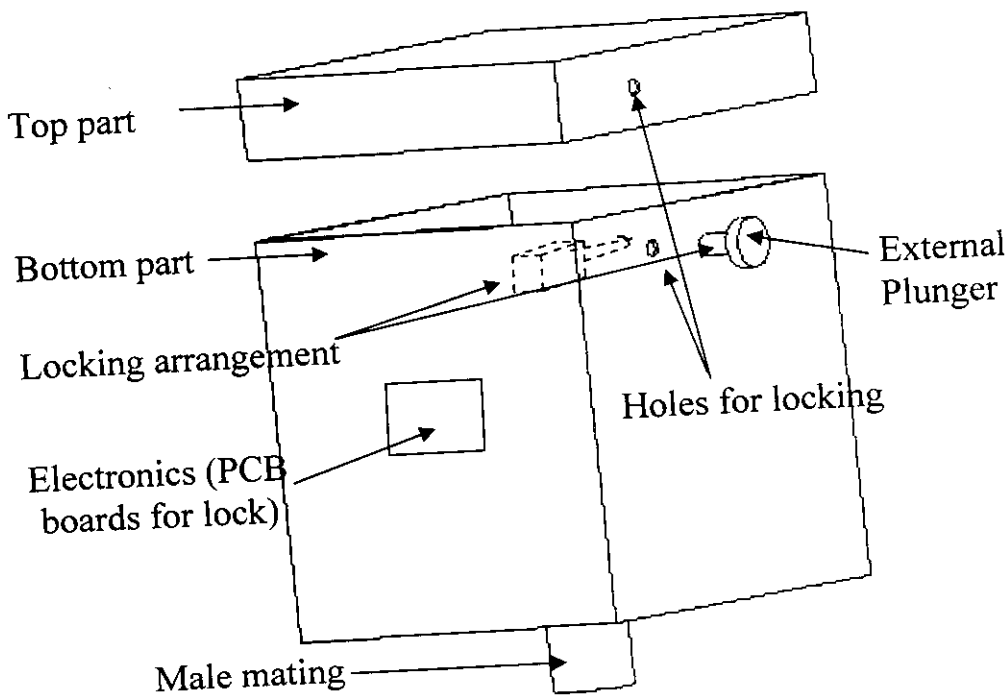


Figure.2d parts of charging container

2.2.2 Electronic locking system

2.2.2.1 General concept

Electronic locking system is provided, so that the container can be opened by pressing a four digit code. This container will be opened in the company where it is to be cleaned and filled with fresh milk. The four digit code will be known only to the company people. The container will not be opened anywhere else. The code should be maintained as secret.

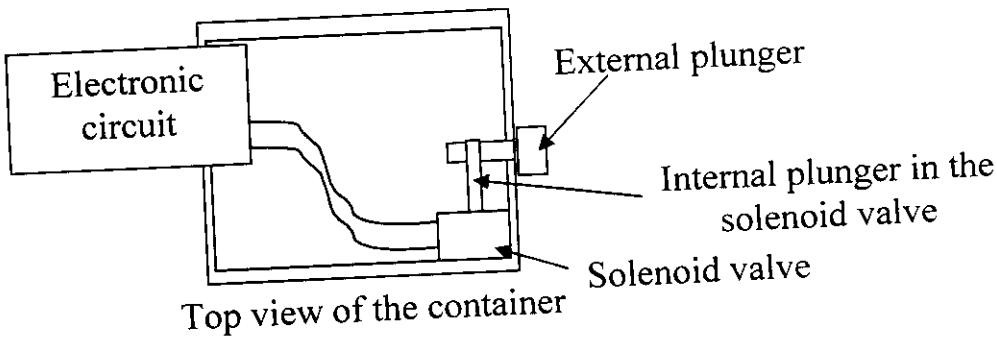


Figure.2e parts of the locking system

2.2.2.2 Circuit description

This intelligent lock unit is built using transistors only. To open this electronic lock, one has to press tactile switches s1 through s4 sequentially. For deception you may annotate these switches with different numbers on the keypad.

For example, if you want to use ten switches on the keypad marked 0 through 9, use four arbitrary numbers out of these for switches s1 through s4, and the remaining six numbers may be annotated on the leftover six switches, which may be

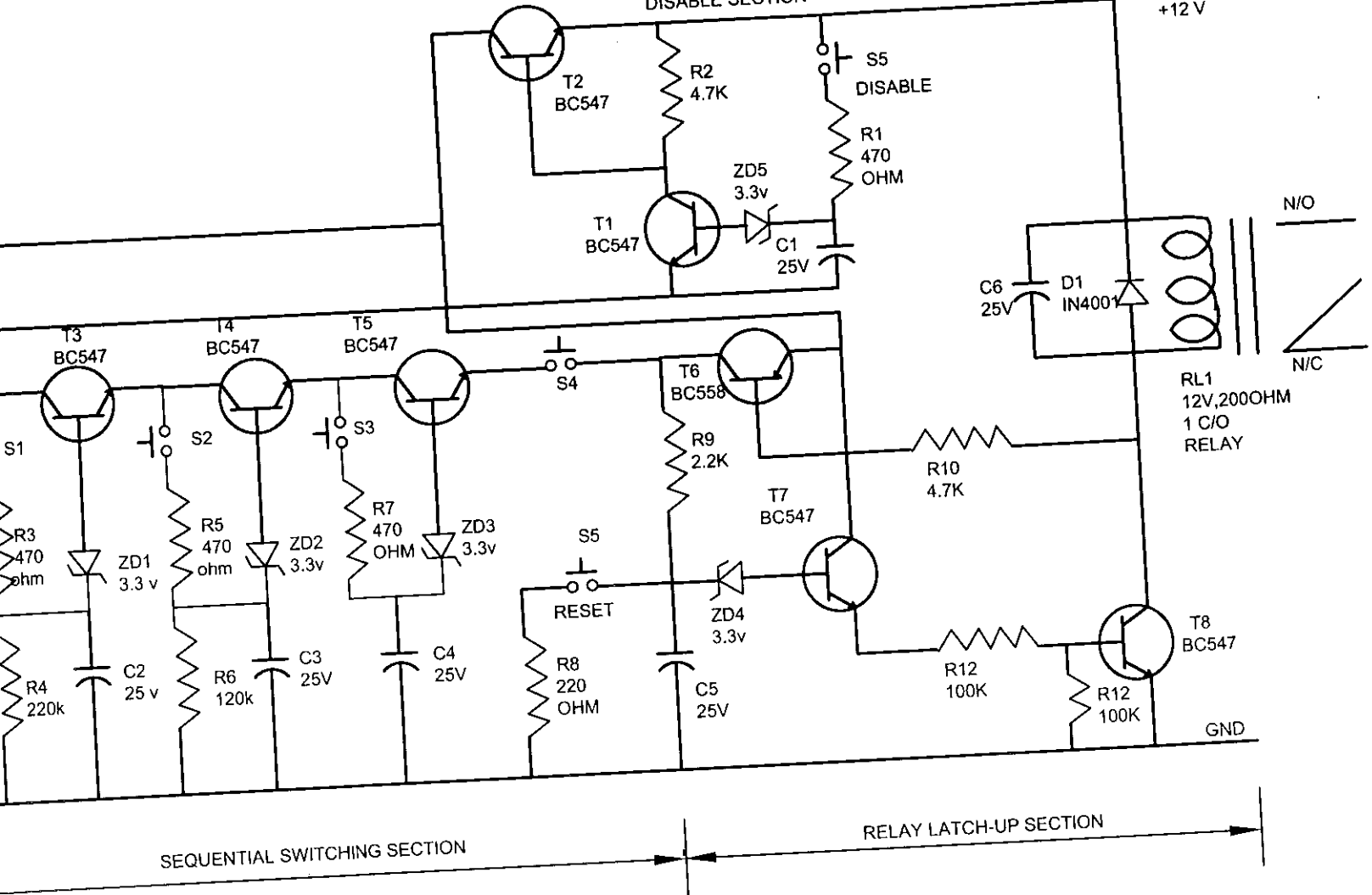
wired in parallel to disable switch s6. When four password digits in 0 through 9 are mixed with the remaining six digits connected across disable switch terminals, energisation of relay RL1 by unauthorized person is prevented. For authorized person, a 4-digit password number is easy to remember.

To energize relay RL1, one has to press switches s1 through s4 sequentially within six seconds, making sure that each of the switch is kept depressed for duration 0.75 seconds to 1.25 seconds. The relay will not operate if 'on' time duration of each tactile switch is less than 0.75 seconds or more than 1.25 seconds. This would amount to rejection of the code.

A special feature of this circuit is that pressing of any switch wired across disable switch (s6) will lead to disabling of the whole electronic lock circuit for about one minute. Even if one enters the correct 4-digit password number within one minute after 'disable' operation, relay RL1 won't get energized. So if any unauthorized person keeps trying different permutations of numbers in quick successions for energisation of relay RL1, he is not likely to succeed. To that extent, this electronic lock circuit is foolproof.

This electronic lock circuit comprises disabling, sequential switching, and relay latch-up sections.

The disabling section comprises zener diode ZD5 and transistors T1 and T2. Its function is to cut off positive supply to sequential switching and relay latch-up sections for one minute when disable switch S6 (or any other terminal shunted across its terminal) is momentarily pressed.



INTELLIGENT LOCK CIRCUIT | figure 2f

During idle state, capacitor C1 is in discharged condition and the voltage across it is less than 4.7 volts. Thus zener diode ZD5 and transistor T1 are in non-conduction state. As a result, the collector voltage of transistor t1 is sufficiently high to forward bias transistor T2. Consequently, +12v is extended to sequential switching and relay latch-up sections.

When disable switch is momentarily depressed, capacitor c1 charges up through resistor R1 and the voltage available across C1 becomes greater than 4.7 volts. Thus zener diode ZD5 and transistor T1 starts conducting and the collector voltage of T1 is pulled low. As a result, transistor T2 stops conducting and thus cutoff positive supply voltage to sequential switching and relay latch-up sections.

Thereafter, capacitor C1 starts discharging slowly through zener diode ZD5 and transistor T1. It takes approximately one minute to discharge to a sufficiently low level to cut off transistor T1, and switch on transistor T2, for resuming supply to sequential switching and relay latch-up sections; and until then the circuit does not accept any code.

The sequential switching section comprises transistor of T3 through T5, zener diodes ZD1 through ZD3, tactile switches S1 through S4, and timing capacitors C2 through C4. In this three stage electronic switch the three transistors are connected in series to extend positive voltage available at the emitter of transistor T2 to the relay latch-up circuit for energizing relay RL1.

When tactile switches S1 through S3 are activated, timing capacitors C2, C3, and C4 are charged through resistors R3, R5, and R7 respectively. Timing capacitor C2 is discharged though resistor R4, zener diode ZD1, and transistor T3; timing capacitor C3 through

resistor R6, zener diode ZD2, and transistor T4; and timing capacitor C4 through, zener diode ZD3, and transistor T5 only. The individual timing capacitors are chosen in such a way that the time taken to discharge capacitor C2 below 4.7 volts is 6 seconds, 3 seconds C3 and 1.5 seconds for C4.

Thus while activating tactile switches S1 through S3 sequentially, transistor T3 will be in conduction for 6 seconds, transistor T4 for 3 seconds, and transistor T5 for 1.5 seconds.

The positive voltage from the emitter of transistor T2 is extended to tactile switches S4 only for 1.5 seconds. Thus one has to activate S4 tactile switch within 1.5 seconds to energize relay RL1. The minimum time required to keep switch S4 depressed is around 1 second.

For sequential switching transistors T3 through T5, the minimum time for which the corresponding switches (S1 through S3) are to be kept depressed is 0.75 seconds to 1.25 seconds. If one operates these switches for less than 0.75 seconds, timing capacitors C2 through C4 may not get charged sufficiently. As a consequence, these capacitors will discharge earlier and any one of the transistors T3 through T5 may fail to conduct before activating tactile switch S4. Thus sequential switching of the tree transistors will not be achieved and hence it will not be possible to energize relay RL1 in such a situation.

A similar situation arises if one keeps each of the mentioned tactile switches depressed for more than 1.5 seconds. When the total time taken to activate switches S1 through S4 is greater than 6 seconds, transistor T3 stops conducting due to time lapse. Sequential switching is thus not achieved and it is not possible to energize relay RL1.

The latch-up relay circuit is built around transistors T6 through T8, zener diode ZD4, and capacitor C5.

In idle state, with relay RL1 in de-energized condition, capacitor C5 is in discharged condition and zener ZD4 and transistor T7, T8 and T6 in Nonconduction State.

However, on correct operation of sequential switches S1 through S4, capacitor C5 is charged through resistor R9and the voltage across it rises above 4.7 volts. Now zener diodes ZD4 as well as transistors T7, T8 and T6 start conducting and relay RL1 is energized. Due to conduction of transistor T6, capacitor C5 remains in charged condition and the relay is in continuously energized condition.

Now, if you activate reset switch S5 momentarily, capacitor C5 is immediately discharged through resistor r8 and the voltage across it falls below 4.7 volts. Thus, zener diode ZD4 and transistor T7, T8 and T6 stops conducting again and relay RL1 de-energizes.

2.2.2.3 Solenoid valve

We have purchased a solenoid valve, manufactured by Janatics India private limited, Coimbatore. And we followed the concept of reverse engineering for applying it for our application. A solenoid used to pull the plunger (internal plunger) when it is energized. So normally the plunger will be in extended position, and while it is energized it will be pulled back. Therefore to lock the container the internal plunger should inside the slot provided in the external plunger (extended position, when it is not energized). When it is energized the internal plunger comes out of the slot and container can be opened.

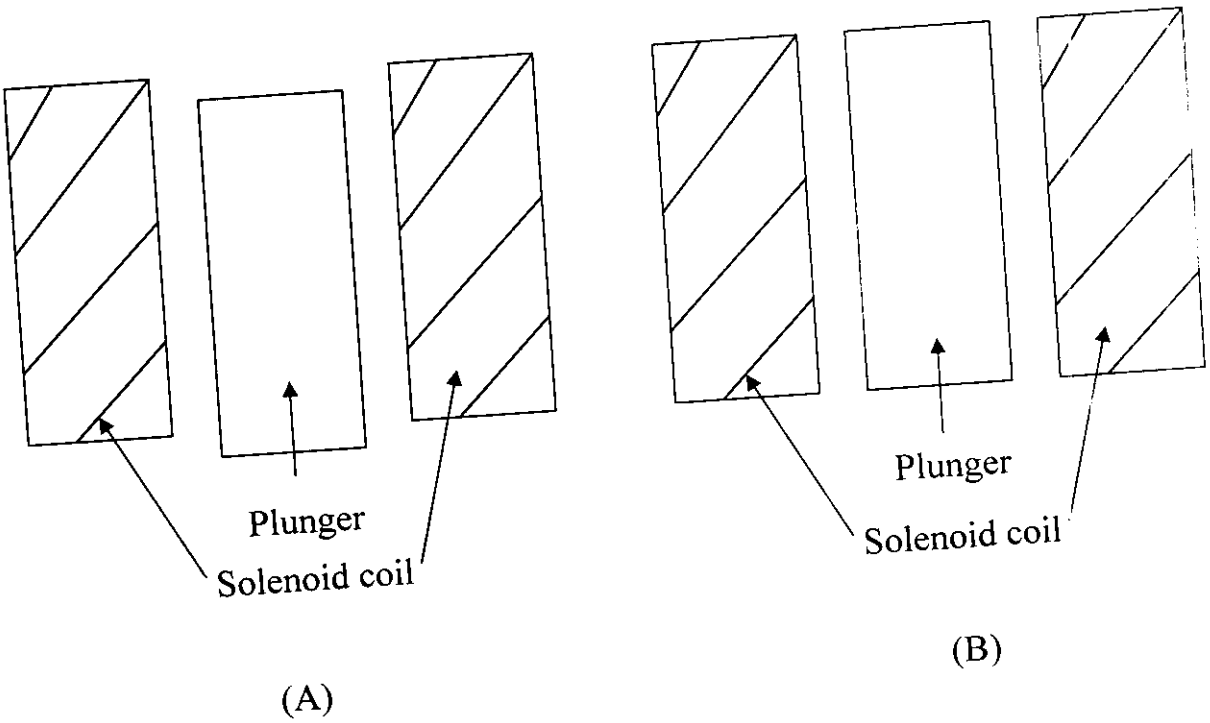


Figure.2g A. normal position B. energized positions

The specifications of the solenoid valve is given in appendix c and appendix d shows the dimensional diagrams for changes made.

2.3 Stirrer

2.3.1 Existing stirrer

The existing stirrer is made up of stainless steel. It is rotated by 0.25hp motor at 30 rpm. The end of the stirrer has a flat part, which seats on the slot present in the motor shaft.

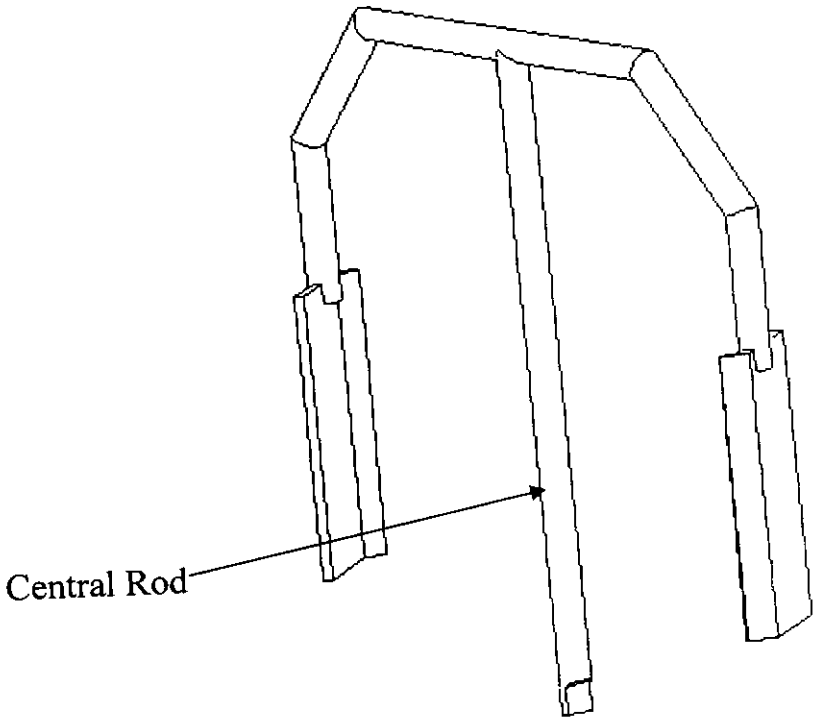


Figure.2h Existing stirrer

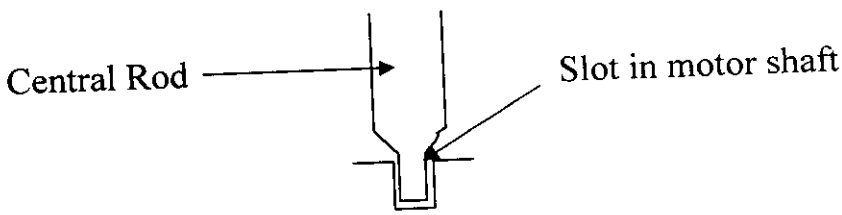


Figure. 2i Rod & shaft arrangement

2.3.2 Modified stirrer

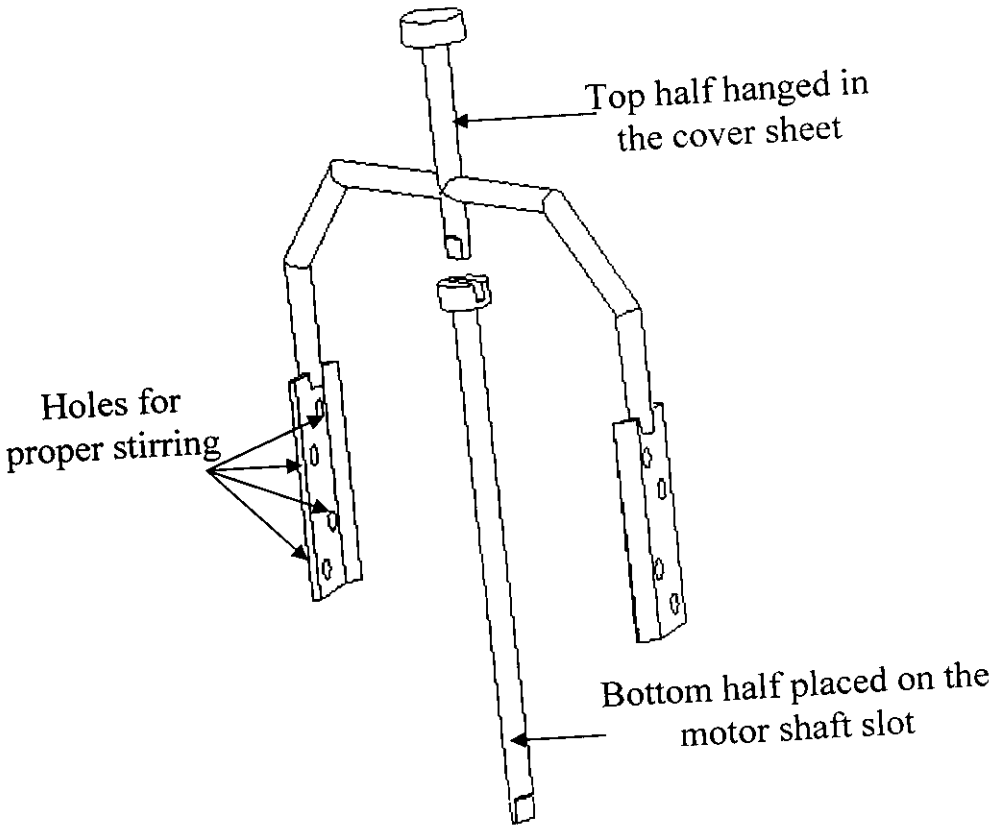


Figure. 2j parts of modified stirrer

Since the stirrer has to be taken out in the existing container while cleaning, the stirrer has been split into two parts as shown in the above figure. Note that, in the existing container the container cannot be taken out without taking the stirrer.

The present capacity of the motor is that it can rotate only at 30 rpm and not above that. And due to this the stirrer rotates slowly. So to have proper stirring and to increase the speed, by lowering the load, we have drilled holes in the surface of the stirrer, because of

which the resistance between the surface ands the milk reduces. And here too the material is stainless steel.

2.4 Charging system

As previously discussed, the charging container should be place over the mother container for filling milk. At this time both the male and female mating parts must be in contact.

Here too we have used two 2/2 way direction control solenoid valves (normally closed), one for mother and the other for the charging container. The cross-sectional details are similar to the solenoid valve shown in the locking section. But here the plunger is used to interrupt the flow of fluid by extension and retraction. When it is retracted the valve is open and the fluid can flow. When it is in extended position the valve is closed and the fluid cannot flow.

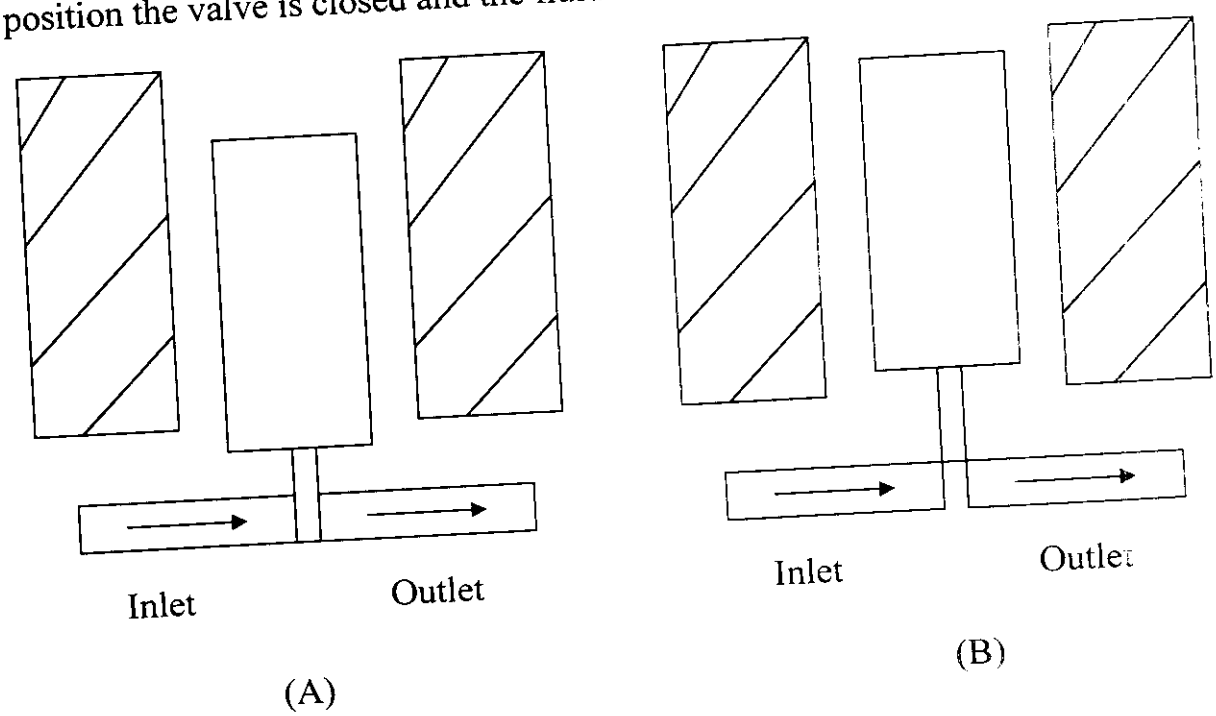


Figure. 2k A. valve closed B. valve open

2.4.1 Transmitting and receiver section

The electronics system consists of four LED and four receivers both of which are fixed to the nozzle connected to the mother and the charging containers respectively. The nozzle is covered by the solenoid valve which opens it when excited. The four LEDs are connected to the supply through a 1k resistor so that it bypasses the current other than what the LEDs require.

The output of the receiver is connected to one input of the Ex-or gate (IC 4030). The receiver is a phototransistor whose base is a light triggered and will switch on when exposed to light. In the receiver, there are two pins one of which is connected to the supply and the other to the input of the Ex-or gate. The working of the receiver is based on the fact that when light is exposed to the receiver, the supply from the collector goes to the emitter.

So the four outputs of the receiver are connected to one input (Bn) of four ex-or gate so that if receiver receives the light signal the input to the gate will be one and if not the input will be zero. The other input to the gates is the supply given to the LED's and this input will always be one. As the operation of the Ex-or gate is that if both the inputs are equal it will give a zero output.

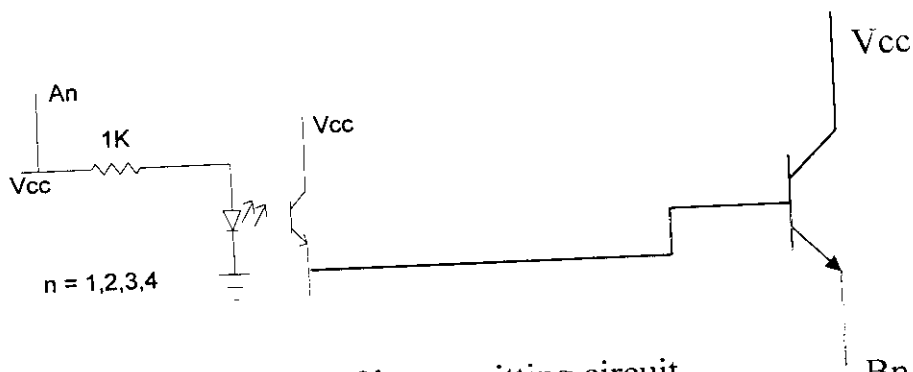
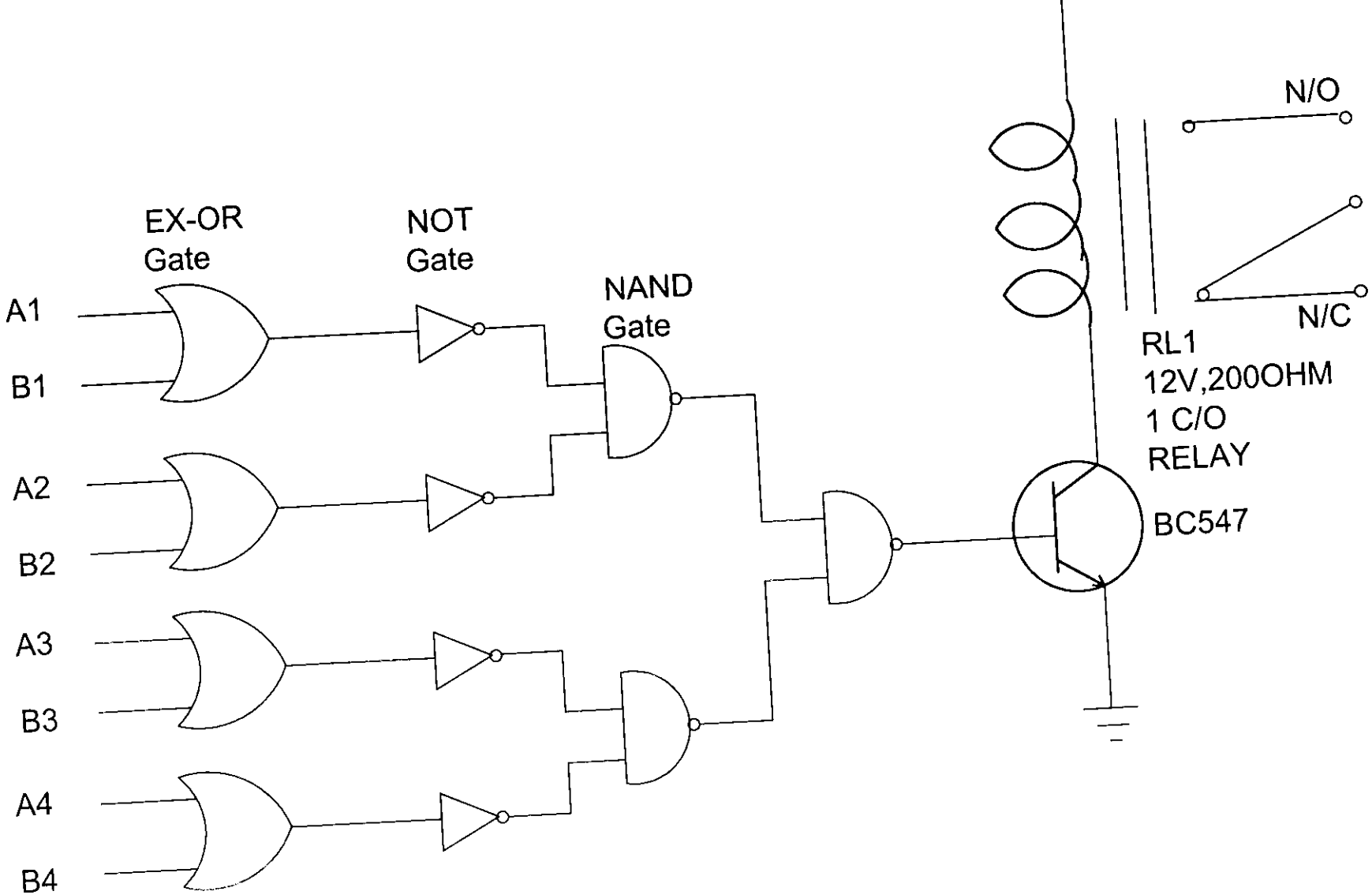


Figure 21 transmitting circuit



CHARGING CIRCUIT | figure 2m

This output of the Ex-or gate is given to input of the NOT gate (4069) so that it will invert the input and give output as 1. So we get four 1's at the output of a NOT gate. Out of this four, two of them are given to one NAND (4011) gate and other two to another NAND gate. The function of the NAND gate is that it will give zero as output if both the inputs are one and give one for other set of inputs. So the two NAND gate give zero as a output which is given to the NOT gate to get a inverted output which in turn given to a NAND gate again so that we get final output as zero.

This zero output is given to a PNP transistor connected in series with the final NAND gate output through a resistor. The collector of the transistor is grounded and the emitter is connected to the supply through a relay network. So if the gate receives the zero input, the transistor will be switched on and the supply will pass through the relay, so that the relay coil will be excited which in turn switches the two solenoid valves covering the charging hole. So if the LED is cutoff or the receiver does not receive the signal correctly, the gate will not be switched on and the relay will not be excited.

That is if the receiver does not receive the correct signal from the LED the output of the receiver will be zero which in turn forms the input of Ex-or. As now the Ex-or gate receives one (as it is connected to supply) and zero, the output will be one which connected to NOT gate give an inverted zero as output. This in turn connected to two NAND gate give output as one which again inverted and given as input to the NAND gate which will give final output as one. So this connected to the base of the transistor may not switch on it, relay will not be excited, and the solenoid valve will not be opened.

We used three IC's for the purpose to serve as a gate, which is a quad gate which contains four gate network in each IC. This circuit is complete foolproof one as electronics behind is hard to be imitated and be cheated. Also the supply to the Led and the other ones in the charging container through a contact points in both the lock and key in the charging and mother container. So the vendor can never easily open the solenoid valve by simply placing four LED's above the receiver as the supply to the solenoid also given through contact points.

In addition, the supply to IC also given by the contact point's only (i.e.) one contact point in the key arrangement is connected to main supply and other to the supply pin of three IC's. The other two contact points in the lock which exactly matches with these two points in the key when both are mated are interconnected. So if four of them are connected the supply will be passed to the IC and the entire circuit functions and the required function is obtained. Moreover, if the charging container is lifted the contacts will cut-off and the IC will not get supply and the solenoid valve will be closed.

This contact point makes system very more foolproof one. Also it will be hard for the vendor to found an alternate for this arrangement and it will prevent from mixing water with beverage.

2.4.2 Mating section

The mating section consists of two parts namely male mating part and female mating part. These parts are made of aluminium and manufactured by CNC machining process. Electrical contact points are made at contact surface of the two mating parts. And only if they are

in contact the two solenoid valves will be kept opened, otherwise they will be in closed positions.

We have made this out of aluminium just to show a model, but we suggest making these mating parts out of non-conducting material, the best would be plastics.

2.4.2.1 Male mating part

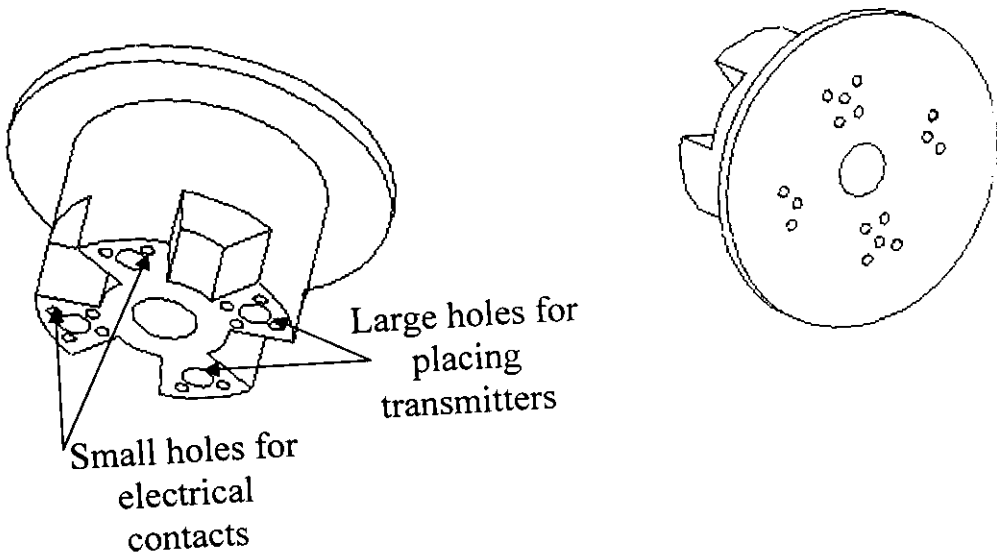


Figure. 2n male mating part

Two different views are shown in the above figure and the holes shown are through holes, thereby we can pass the wires through one end and take it out at the other end for holding connections with the circuit.

2.4.2.2 Female mating part

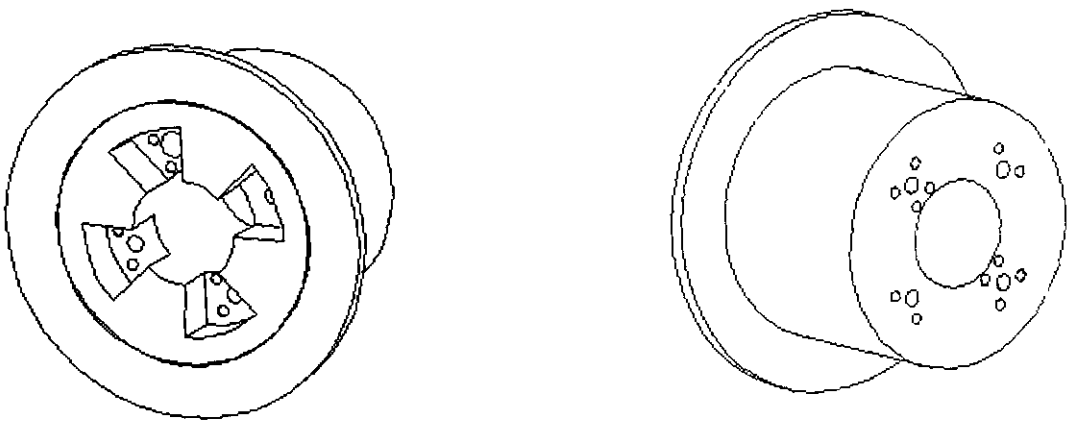


Figure. 2o female mating part

The male mating part exactly matches with the female container and the holes in both the mating parts should match. This will ensure opening of both the solenoid vales. If the valves are not properly placed the valves will not open.

2.5 Contamination detection system

2.5.1 pH sensor

pH sensor measures the degree of acidity or alkalinity to be displayed analogously or digitally.

Each aqueous solution has a certain measure of acidity or alkalinity, which depends upon the amount of hydrogen ions present in the solution. The higher the concentration, the higher the acidity, and the lower the pH. When the concentration is low (very few hydrogen ions),

the pH is high and the solution is alkaline. A pH below 7 indicates alkalanity.

The pH is defined as the logarithm of the reciprocal of the hydrogen ion concentration, (H+), i.e. pH = $\log_{10}$ 1/(H+). Table1 gives the pH scale with corresponding number of grams of hydrogen ions per liter of solution, and tipical examples.

A neutral value does not correspond to a concentration of zero ions, but to one which lies at the division between acidity and alkalinity (pH of 7). The concentration is aldo dependent on the temperature of the solution. Depending on the nature of the solution the temperature is either direct or inverse. Measurement of the pH is normaly related to a temperature of 25°C.

There are two methods for determining the number of H+ ions in an aqueous solution: colorimetry and electrometry. In the first, an acid base indicator is used, which has a different colour in acid or base solutions. The colour change is due to a marcked difference in colour between the undissociated and ionic forms. Such indicators are accurate only to about 30%.

The electometric based on comparing the voltage measured by a sensor and a reference potential.

The output potential of the sensor changes by about 59mv per pH unit; this is a reasonable value which can be measured with a d.c. voltmeter.

In pH measurements use is made of the potential difference between a metal electrode and the electrolyte into which it is immersed. Such a potential difference also exists between two different electrolytes. Electrolytes may be acids, bases, or salts.

In the sensor used here. There are a reference electrode and a measuring electrode. The reference voltage provides a fixed galvanic voltage between it and the electrolyte to be measured. It consists of a rod of silver compound which is surrounded by a buffer solution, potassium chloride (kcl). The potassium chloride is connected with the electrolyte via a diaphram which ensures minimal liquid transfer and very low electrical resistance. In the sensor used here, the diaphragm is made up of porous cerami.

The measuring electrode consists of a silver rod which is bonded to a glass membrane and surrounded by a potassiumchloride solution. A potential difference will arise across the membrane which is dependent upon the difference in acidity/alkalinity between the buffer solution inside the sensor is immersed. The potential difference is probably caused by an exchange of sodium and hydrogen ions between the glass and the solutions.

The potential differnce between the electrodes is greatly proportional to the difference in pH of the buffer solution and the electrolyte. All other galvanic voltages cancel each other. Because of the high transfer resistance of the measuring electrode, and to prevent chemical changes in the solutions, the measuring device interconnecting the two electrodes externally must have a very high impedance input of the order of $10_{12}\Omega$.

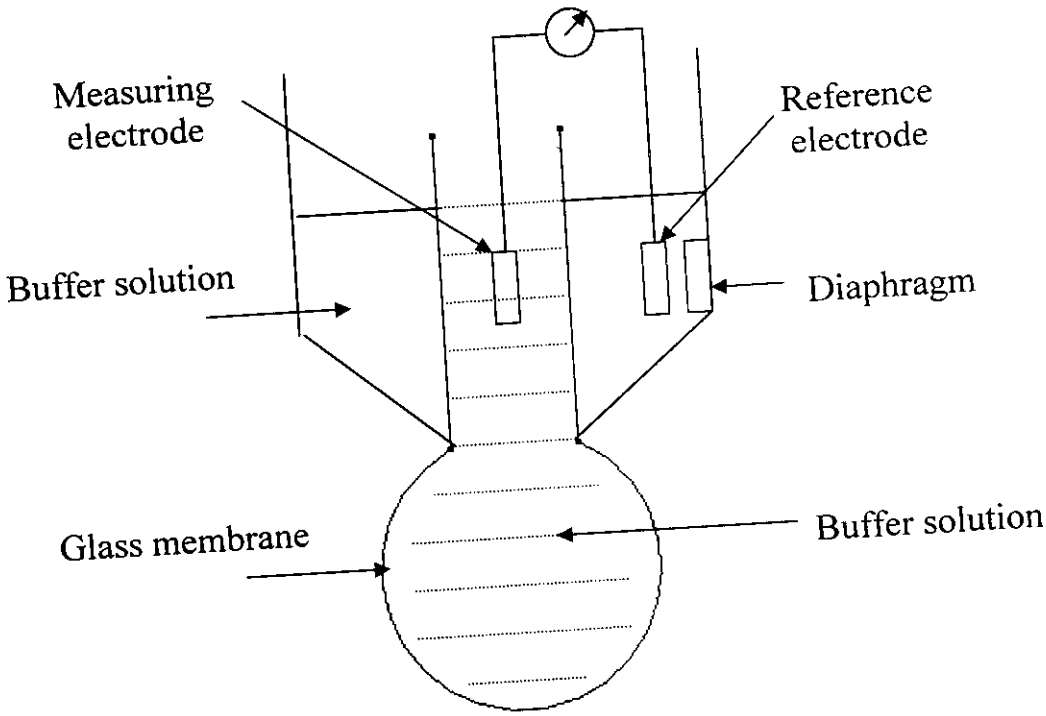


Figure .2p pH sensor

TABLE 1 pH scale with corresponding number of grams of H+ ions/litre.

pH	Hydrogen ions in g/lit	Relative strenght	Example
0	1.0	10000000	5% hcl
1	0.1	1000000	Gastric juice
2	0.01	100000	Lemon juice
3	0.001	10000	Wine
4	0.0001	1000	Beer
5	0.00001	100	Black coffee
6	0.000001	10	Mineral water
7	0.0000001	0	Fresh milk
8	0.00000001	10	Washing soda
9	0.000000001	100	Borax solution

10	0.0000000001	1000	Soapy water
11	0.00000000001	10000	Film developer
12	0.000000000001	100000	Ammonia sol.

We have taken various temperature and voltage readings for milk using this sensor and developed the circuit. The readings are shown in table 2. The readings are taken for good and contaminated milk.

For this pH sensor to be used in our project we required certain readings like the output value of pH sensor at different temperature for both fresh milk and contaminated milk. We noted certain readings in our lab and they are listed below

TABLE 2

Sensor outputs for fresh & contaminated milk

Fresh milk	
Temperature (°C)	Voltage (mv)
5	0.1
6	0.1
10	0.1
13	0.2
15	0.2
19	0.3
23	0.4
24	0.5
25	0.6

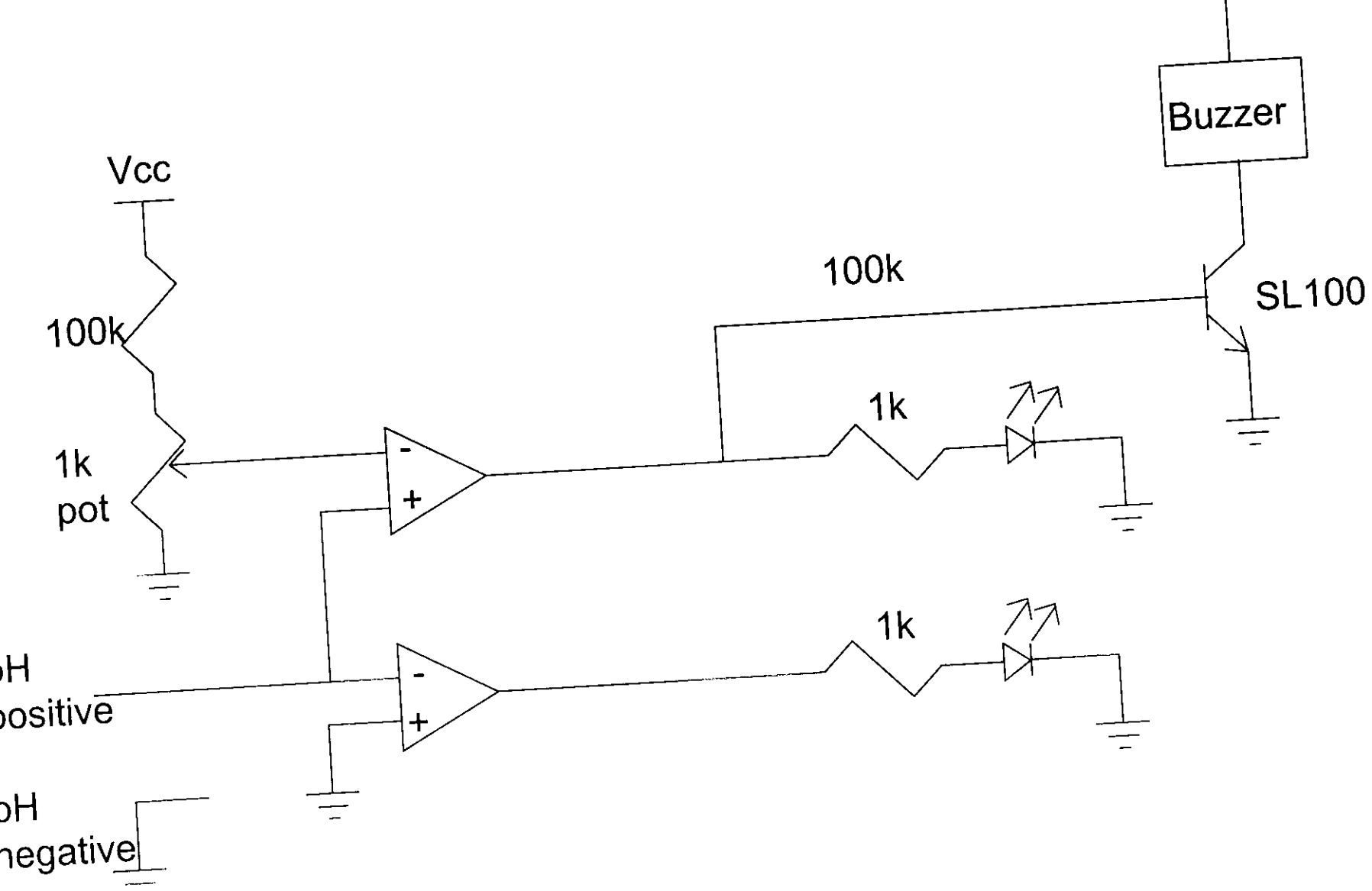
26.5	0.7
27	0.8
28	0.9
29	1.1
30	1.2
31	1.3
32	1.5

Contaminated milk	
5	0.9
10	1
11	1.1
15	1.3
20	1.5
22	1.7

2.5.2 Detection circuit

For our project, we use the operational amplifier in the comparator mode to check whether the milk is contaminated or not. Here a known reference voltage is compared with the pH sensor output and the required output is indicated using and LED and a buzzer which just indicate and warn the dealer that the milk is contaminated. The further development can be done to stop the whole system with the output of op-amp.

To make this circuit possible we required various range of input from the pH sensor. For this purpose, we noted various



pH TESTING CIRCUIT | figure 2q

values of output from the sensor for both the fresh milk and the contaminated milk at different temperature values. The pH output is a millivolt that varies with the temperature and for the contamination. From the various millivolt ranges, it is noted that for a fresh milk the voltage ranges from (0.1 to 0.6mv) for the temperature between 5^0 to room temperature.

2.6 Electronic flow control system

The electronic flow control is designed to dispense different quantities of milk by adjusting a rotary switch. We have designed for five different quantities.

2.6.1 Circuit

The 555 timer is a highly stable device for generating time delay or oscillation. A single 555 timer can provide time delay ranging from microseconds to hours whereas counter timer can have a maximum timing range of days.

The 555 timer can be used with supply voltage in range of +5 v to +18 v and can drive load up to 200 mA. It is compatible with both TTL and CMOS logic circuits. Because of the wide range of supply voltage, the 555 timer is versatile and easy to use in various applications. Its various application includes oscillator, burglar alarm, traffic light control and voltage monitor etc.

For our need we use the 555 timer in a monostable mode in order to generate output voltage for required amount of time if a negatively going triggering pulse is given to its 2^{nd} pin. The operation in

this mode suits to our project as we have to open the flow point for the required time to dispense the required amount of beverage. Let's see the operation of 555 timers in this mode in detail.

In this standby state, the flip-flop inside the timer holds the transistor 1 on, thus clamping the external timing capacitor to ground. The output remains at ground potential, i.e. low. As the trigger passes through vcc/3, the flip-flop is set i.e. Q1=0. This makes the transistor 1 off and the short circuit across the timing capacitor is released. As q1 IS low, output goes high, the timing cycle now begins. Since capacitor C is unclamped, voltage across it rises exponentially through resistor R towards supply through time constant RC. After a time period T the capacitor voltage is just greater than (2/3) supply and the upper comparator resets the flip-flop. This makes Q1 = 1, transistor 1 on, thereby discharging the capacitor C rapidly to ground potential. The output returns to the standby state or ground potential.

To calculate the required RC value for the various times we need is calculated using the formula,

$$Vc = Vcc\ (1 - e^{-t/RC})$$

At t = T,

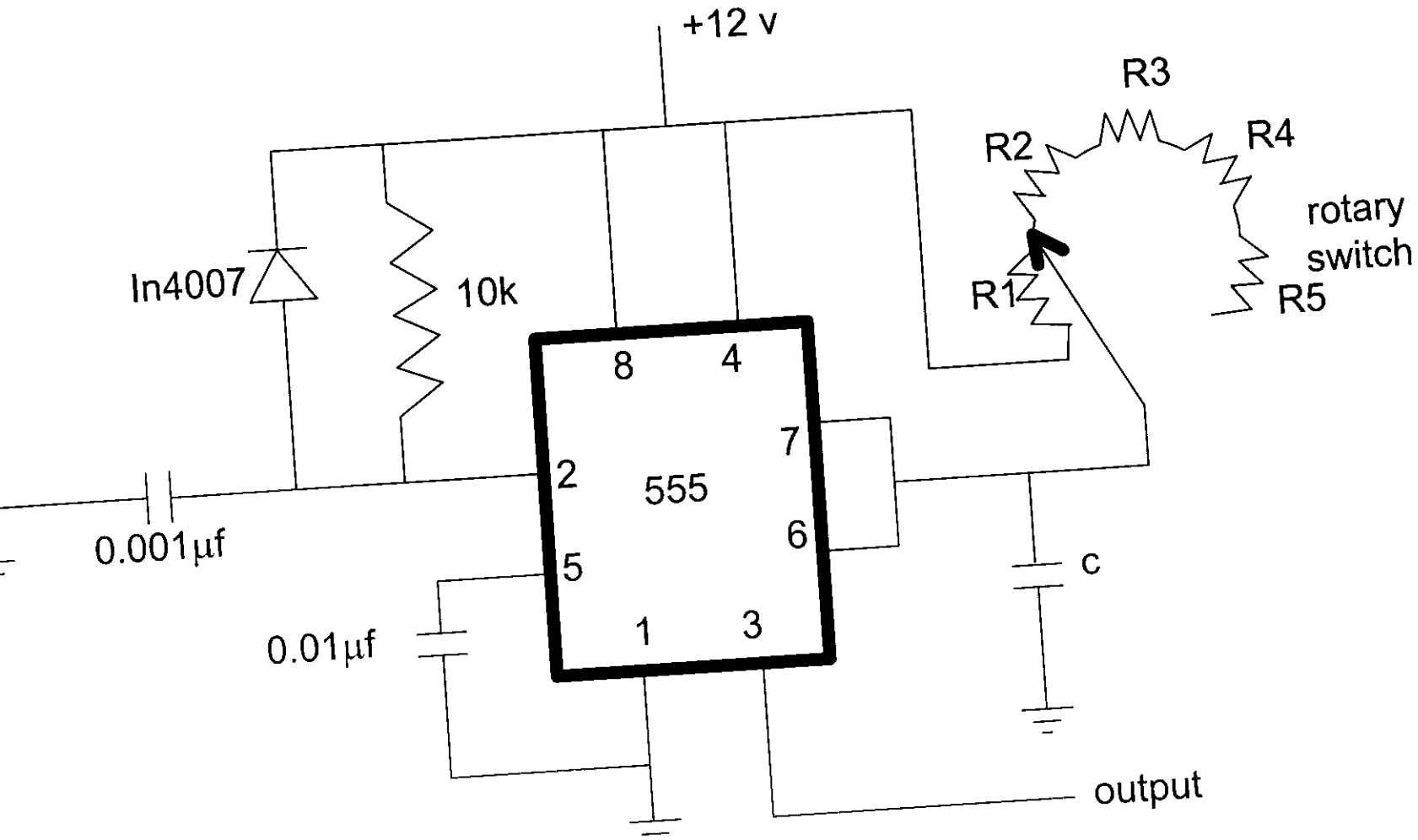
$$Vc = (2/3)\ Vcc$$

$$2/3\ Vcc = Vcc\ (1 - e^{t/RC})$$

$$T = RC\ ln\ (1/3)$$

$$T = 1.1\ RC\ (seconds)$$

In the above formula we know the time value we needed, so by fixing the capacitor C value we can calculate the various resistor value for the required output we needed.



FLOW CONTROL CIRCUIT	figure 2r

It is also seen from the formula that the timing interval is independent of the supply voltage. It may also be noted that once triggered, the output remains in the high until time T elapses, which depends only upon R and C. any additional trigger pulse during this time will not change the output state. However, if a negative going reset pulse is applied to the reset terminal (pin4) during the time cycle, transistor 2 goes off, transistor 1 becomes on and the external timing capacitor C is immediately discharged. It may be seen that the output of transistor 2 is connected directly to the input of transistor 1 so as to turn on 1 immediately and thereby avoid the propagation delay through the flip-flop. Now, even if the reset is released, the output will still remain low until a negative going trigger pulse is again applied to pin 2.]

Sometimes the monostable circuit mistriggers on positive pulse edges, even with the control pin bypass capacitor. To prevent this a more practical circuit is available and we used it for the purpose of our project. Here the resistor and capacitor combination of 10k and 0.001μf at the input differentiator. During the positive going edge of the trigger, diode D becomes forward biased, thereby limiting the amplitude of the positive spike to 0.7 v.

4. COST DETAILS

CHARGING AND MOTHER CONTAINER

Aluminum Welding cost	RS. 420.00/-
Aluminium fabrication cost	RS. 250.00/-
Solenoid valve – 3 NOS & D.C. plunger	RS. 1922.48/-
Material cost	RS. 675.00/-
Acrylic material & working cost	RS. 552.00/-
Lock and key manufacturing	RS. 1800.00/-
D.C valve for code lock	RS. 579.94/-
PCB for code lock	RS. 560.00/-
PCB for transmitter and Receiver	RS. 590.00/-
TOTAL	RS. 7349.42

pH for contamination Checking

pH meter and sensor	RS. 3000/-
Buffer solution	RS. 315.50/-
Wash bottles	RS. 53.00/-
Milk	RS. 105.00/-
TOTAL	RS. 3473.40/-

Stirrer

Manufacturing	RS. 500/-
Material	RS. 200/-
Total	RS. 700/-

Electronics

Components	RS. 1034.00/-
Power supply	RS. 264.00/-
Total	RS. 1298.00/-

Grand total

Container	RS. 7054.52/-
pH checking	RS. 3458.40/-
Stirrer	RS. 700/-
Electronics	RS. 1217.88/-
Total	RS.12740.80/-

4. CONCLUSION

The various modules of the project are tested for its functioning and it was sucessful. As we discussed earlier we suggest to make the mating parts and the charging container out of acrylic or plastic. The intial investment of the project may be high but it can be justified for the reasons like security and a choice for the replacement of polythene covers.

The contamination detection system will make sure that the good milk reaches the customers. The flow control system is presently designed for dispensing five finite different quantitties, but the amount of dispensing quantity as well as the number of different quantities that can be dispensed can be changed with minimum modifications.

The project can also be extended to normal milk packet deliveries to common people. To this application our system can be implemented, but we have to install dispensing machines at many centres.

5. REFERENCES

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- Philip Walker, Electronic security systems, Butterworth publications, 2nd edition.
- Electronics handbook volume 1.
- CMOS IC manual.
- William D. Callister, Material science and engineering an introduction, John Wiley & Sons Inc.
- Kim R. Fowler, Electronic Instrument Design, Oxford University Press.

APPENDIX A

CONTACT ADDRESSES OF INDUSTRIES AND SHOPS

Electronic components

1) Sunrise electronics
   721/1, oppanakara street,
   coimbatore- 641001.
   Ph. 0422-2381050.
   E-mail- sunrise1@vsnl.com

2) Ingata laboratories
   686, opppanakara street,
   coimbatore- 641001.
   Ph. 0422-2392101.
   Fax- 0422-2398817/2232159.
   E-mail- ingata@vsnl.net

3) Arsan projects (for PCB works).
   484, vijay complex, II floor,
   near textool, ganapathy,
   coimbatore- 641006.
   Ph. 0422-2530002 mobile- 98422-53370
   Email- arsanprojects@yahoo.com

4) Sunshiv electronic solutions (for PCB works).
   102/5, 4th street
   ambadi bakery 1st floor,
   gandhipuram, coimbatore-641012.

Ph. 0422-2491177 mobile- 98422-02351

Email- sunshiv2002@yahoo.co.in.

Solenoid valves

1) J Vision
   Distributor: janatics pneumatic products.
   8/2, dhandumariamman kovil street,
   avanashi road,
   coimbatore-641018.

Acrylic components

1) A. Edward prince, M.B.A
   Proprietor
   130, church street,
   sowripalayam,
   coimbatore – 641028
   Ph. 0422-2570968.

Stirrer

1) combatore springs
   32, kattabomman street
   ganapathy,
   coimbatore – 641006.
   Ph. 0422- 2532016.

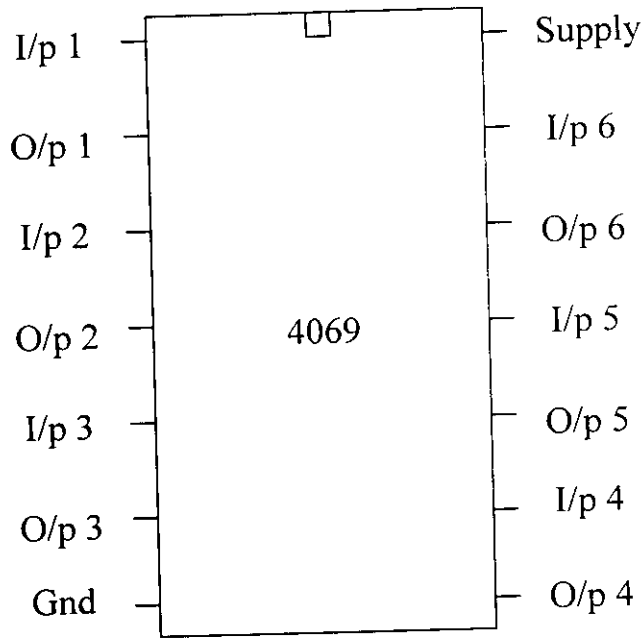
Aluminium component fabrication and welding

1) saghai engineering works.
   13, gandhiji road, sanganoor,
   rathnapuri post,
   coimbatore – 641027.
   Ph. 0422- 2333347.

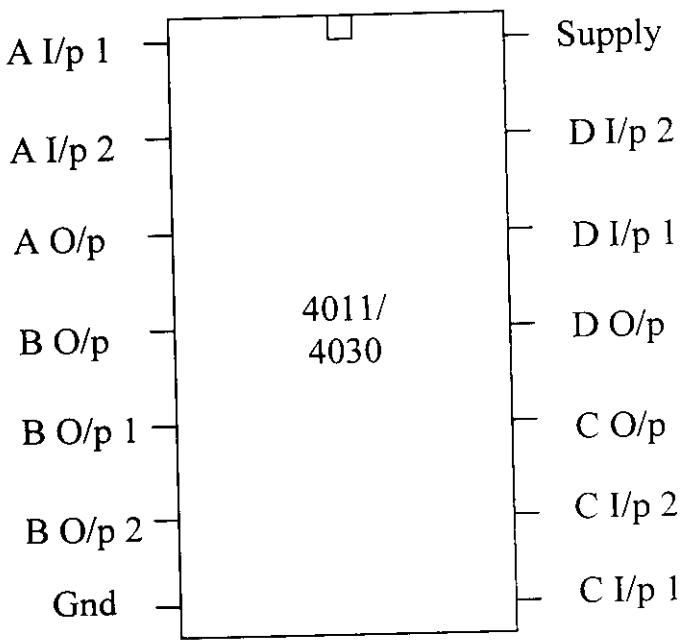
2) vedian CNC and tools
   23, kattabomman street
   ganapathy
   coimbatore- 641006.
   Ph.98430 –35092
   Email vighan@eth.net.

APPENDIX B

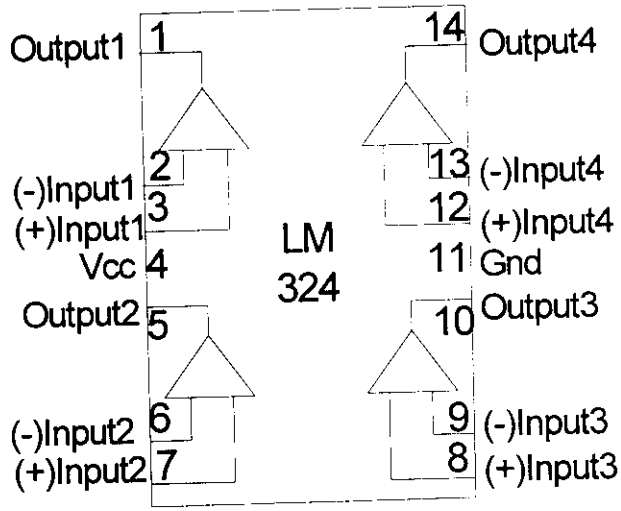
Appendix B -- IC pin configurations.



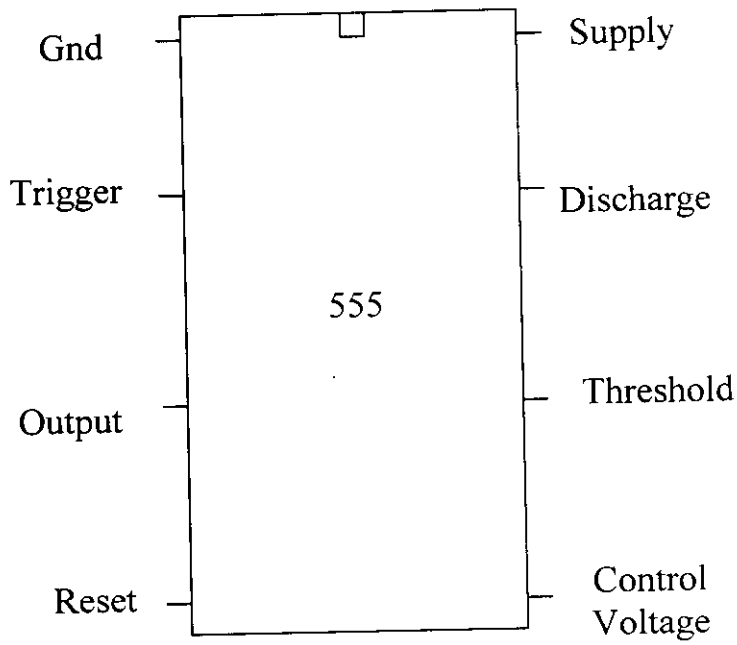
CMOS IC – NOT gate



CMOS IC – 4011- NAND & 4030 – Ex-or

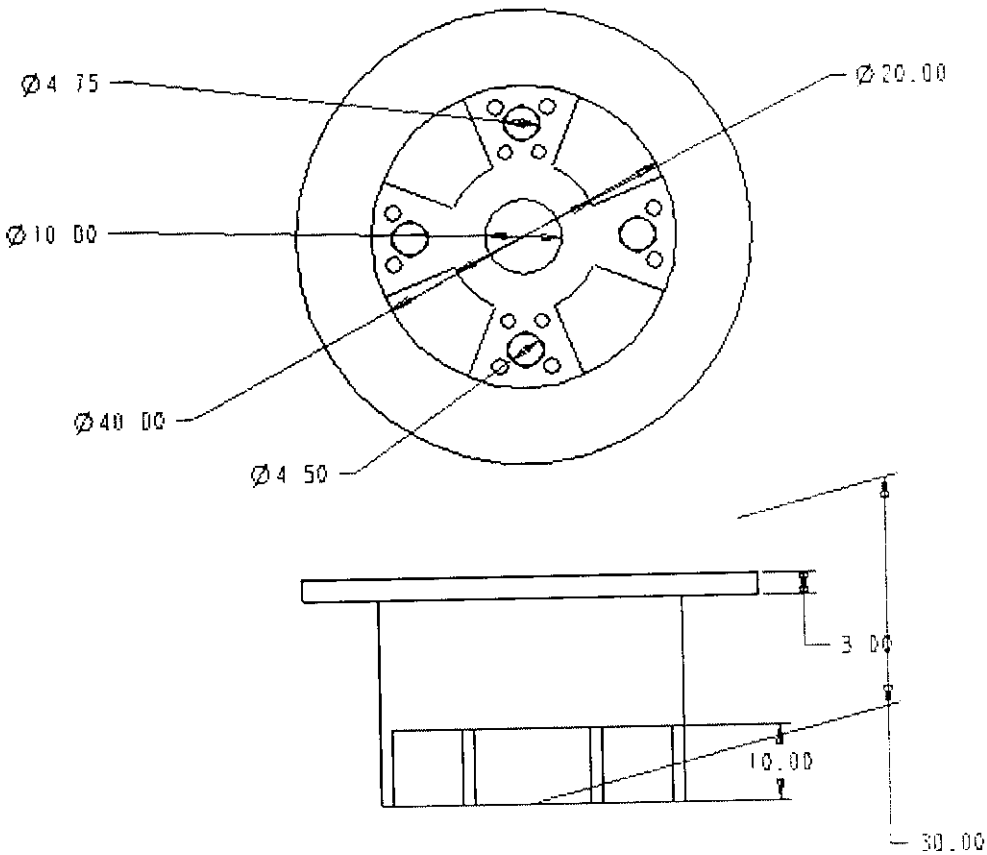


LM324 – op amp IC

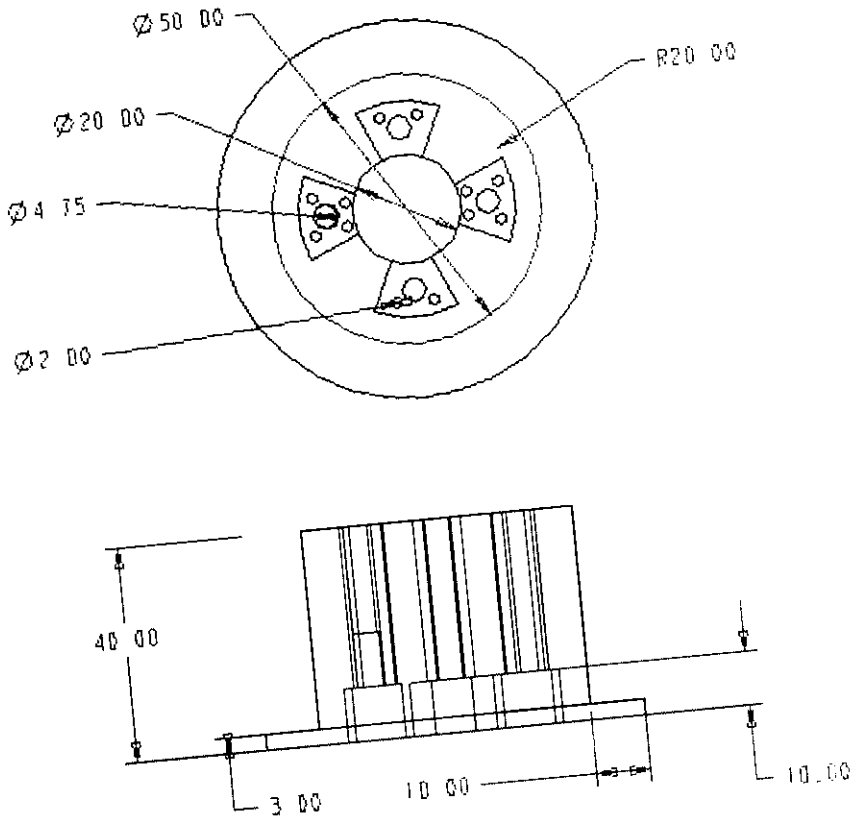


555 Timer IC

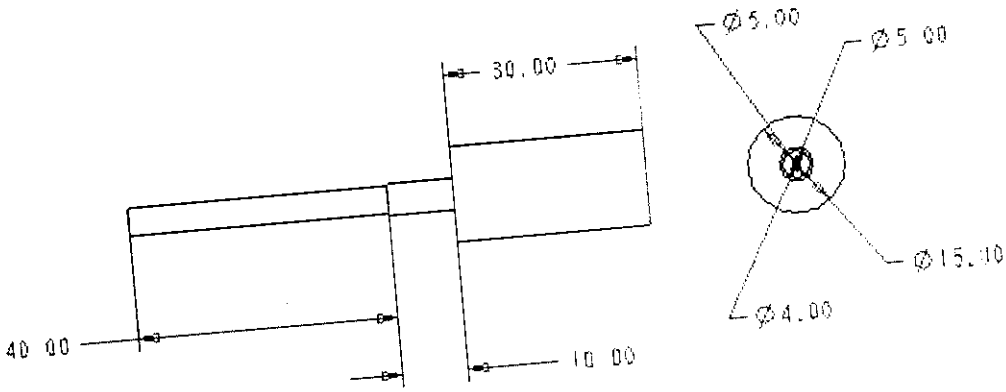
APPENDIX C – DIMENSIONAL DIAGRAMS



Male Mating Part



Female Mating Part



Internal plunger of Solenoid