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Project Title: Advanced Lacto Tester

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1.1 Abstract:

In recent years the National Dairy Development Board-initiated cooperative movement has led to a substantial increase in milk production in India. The two main reasons for this increase are the efficient collection of milk and higher profit for the producers, both of which have to some degree been influenced by information technology. The appropriate information technology described to dairy farmers which helps to make information symmetric in the market, thereby minimizing problems of adverse selection and tedious work. It is only recently that automation has been introduced into agriculture. In many dairy farms, computer aided control of physiological and sanitary parameters is already used and lead to a productivity increase and the elimination of some tedious operations. Embedded Technology is now in its prime and the wealth of knowledge available is mind-blowing. An embedded system can be defined as a control system or computer system designed to perform a specific task. Embedded systems are playing important roles in our lives every day, even though they might not necessarily be visible. Our project describes one of the applications of embedded system ADVANCED LACTOTESTER. It is Small compact, embedded in a single unit, requires less power and measure milk parameters like SNF (Solid but Not FAT), FAT, CLR etc., with less cost. In our project we are using LED for passing light through a milk sample, LDR to sense the scattered light which comes from sample and a load cell to measure the weight of milk sample which helps us to measure the both FAT and SNF values.

1.2 Motivation:

Agriculture is backbone of our country and dairy farming is joint business of Indian farmer. Dairies collect milk from farmer everyday & payments for this milk are done according to the rates per liter. The Dairy industry in India is generally co-operative. The primary milk provided to the dairy are farmers who do not process their milk and give it in the raw form to the co-operative dairy. Since more number of farmers are depositing their milk in the dairy, it is a daily task of the dairy to assess the quality of milk from each farmer, verify it & meets the quality norms specified and make payments based on quality and quantity of milk. Though several tests are available for quality assessment of milk like the content of protein, water, detergent, lactose, etc. Most dairies use only the fat content test and CLR (Corrected Lactometer Reading) to judge milk quality.

As per the existing technology the milk collection centres are using manual methods. They can put the wrong readings and they can also utilise the measuring equipment in a wrong manner. These milk collection centres are doing this fare readings by manual process. So, the dairy farmers are suffering a lot due to these problems. By automating this testing process, we can help the dairy farmers from all these fair collections.

With changing time and development in technology, we are going to design such an instrument that will be useful to an animal farmer in India. Milk tester (called ADVANCED LACTOTESTER) is a very versatile device and is easily available in the form of palm hold, having input for analysing milk. In this we are using LED and LDR assembly to measure the FAT values, load cell to calculate the SNF values which shows the output in the form of LCD display. This is fully microcontroller based instrument low weight and easily accessible to the farmer.

The rate of each component may vary from time to time. Hence for a milk farmer to get paid the amount that is correct, the calculations of these components must be as accurate as possible. As soon as milk sample is kept in the hallow box to measure Fat values led and ldr setup will be used. To obtain the weight and SNF values a weight sensor will be used.

1.3 Purpose:

Indian dairy sector is not technologically up to date, as is the case with all the agricultural sectors in India. One of the main problems faced in the grass-root level of the milk industry is the quality scale (a measure of quality) and successively the methods that are used to implement such a scale for fixing the price. The quality of the milk is the measure of its nutritive value. Since milk is mostly water, the quality is the content of the milk in the form of fats, proteins and sugar. These contents are broadly divided into 2 categories – FAT and SNF (solid not fat). The price of the given sample of milk is set by giving the money based on the amount of these two components.

The purpose of our project is to provide the testing equipment for dairy farmers to test the quality of milk to avoid the fare readings from existing methods and to provide a reliable equipment at low cost.

2.1 Block diagram & Working:

Functional description in general includes the block diagram representing every module of the project and working which specifies the function of each module in the project. The block diagram is shown below fig 2.1 which consists of the Fat measuring module i.e., led and ldr sensors used for detecting the amount of fat intensity in milk sample and along with clr measuring module i.e., load cell with amplifier used to detect the weight of milk sample simultaneously for purpose of calculating specific gravity and corrected lactometer reading so that snf will be determined. A processor like Arm7 LPC2148 is used to take the inputs for this fat measuring and clr measuring modules and calculate all these milk parameters and for the information passage. It also has the LCD display for displaying the milk parameters.

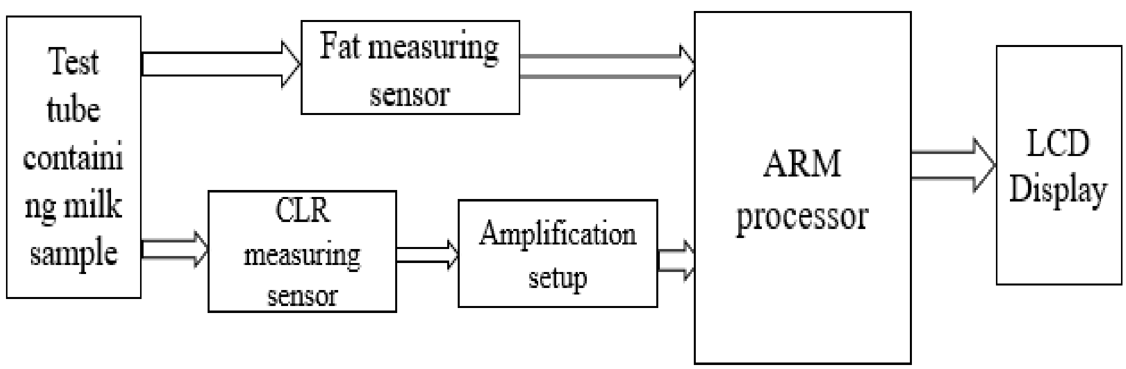

Figure 2.1: Block Diagram of Advanced Lactotester

The milk collected in the milk centers will be tested by taking a sample of milk in a test tube. The test tube containing milk sample is placed in a hollow box where a led and ldr setup present in it. Once the milk sample is placed in between led and ldr arrangement, the light emits from the led will pass through the test tube, the fat molecules present in the milk sample will have the tendency to scatter the light. So that the light scattered from test tube is collected by ldr which is present at the opposite end. Then ldr will changes its resistance according to the light collected and readings will be given to processor. A weight sensor which is placed below the setup of hollow box will used to measure the weight of sample placed. The reading from the weight sensor will be amplified and calibrated which are given for mathematical processing that are used to get Specific Gravity. So that CLR, Fat, Weight and SNF of milk sample are calculated and displayed in LCD Display.

2.2 Technical Specifications:

2.2.1 ARM7 (LPC2148):

ARM7 LPC2148 Microcontroller Socket is used with LPC2148 Pro Development Board. It is a standalone board for LPC2148 microcontroller. It has 12MHz crystal for system clock and 32KHz crystal for RTC. It has power on reset circuit with MCP130T brownout monitoring chip and power decoupling capacitors. This board can be used for LPC2148 based generic development.

Specifications:

- Microcontroller: LPC2148 with 512K on chip memory
- Crystal for LPC2148: 12Mhz
- Crystal for RTC: 32.768KHz
- Operating Supply: 3.3V

Features:

- 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
- 40 kB of on-chip static RAM and 512 kB of on-chip flash memory.
- In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loader software.
- Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with the on-chip Real Monitor software and high-speed tracing of instruction execution.
- USB 2.0 Full-speed compliant device controller with 2 kB of endpoint RAM.
- Two 10-bit ADCs provide a total of 14 analog inputs
- Single 10-bit DAC provides variable analog output
- Two 32-bit timers/external event counters (with four captures and four compare channels each), PWM unit (six outputs) and watchdog.
- Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.
- Multiple serial interfaces including two UARTs, two Fast I^2C-bus (400 kbit/s), SPI and SSP with buffering and variable data length capabilities.

2.2.2 IR Sensor (LTL307EE):

Dominant Wavelength	625 nm
Forward Current	30 mA
Forward Voltage	2 V
Illumination Color	Red
Luminous Intensity	90 mcd
Max Operating Temperature	100 °C
Min Operating Temperature	-55 °C
Number of Elements	1
Number of LEDs	1
Power Dissipation	100 mW

2.2.3 LDR Sensor (ORP12):

A photoresistor or light dependent resistor or cadmium sulfide (CdS) cell is a resistor whose resistance decreases with increasing incident light intensity ie., resistance is inversely proportional to incident light intensity. It responds when the light rays fall on the cadmium sulfide material. It can also be referred to as photoconductor. A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, e.g. silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities, also called dopants, and added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (i.e., longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor.

- Maximum power consumption: 500V DC
- Maximum peak value: 500mW
- Spectrum peak value: 540nm
- Light resistance: 5 to 10k
- Dark resistance: 0.6MΩ

2.2.4 ARDUINO (UNO Rev3):

Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Specifications:

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6 DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed :16MHZ

2.2.5 Load cell amplifier (HX711):

Load Cell Amplifier is a small breakout board for the HX711 IC that allows you to easily read load cells to measure weight. By connecting the amplifier to your microcontroller, you will be able to read the changes in the resistance of the load cell, and with some calibration you'll be able to get very accurate weight measurements. This can be handy for creating your own industrial scale, process control or simple presence detection. Load Cell Amplifier features a few changes that you specifically asked for! We have separated the analog and digital supply, as well as added a 3.3uH inductor and a 0.1uF filter capacitor for digital supply. The HX711 uses a two-wire interface (Clock and Data) for communication. Any microcontroller's GPIO pins should work, and numerous libraries have been written, making it easy to read data from the HX711.

Specifications:

- Two selectable differential input channels
- On-chip active low noise PGA with selectable gain of 32, 64 and 128
- On-chip power supply regulator for load-cell and ADC analog power supply
- On-chip oscillator requiring no external component with optional external crystal
- On-chip power-on-reset
- Simple digital control and serial interface: pin-driven controls, no programming needed
- Selectable 10SPS or 80SPS output data rate
- Simultaneous 50 and 60Hz supply rejection
- Current consumption including on-chip analog power supply regulator: normal operation < 1.5mA, power down < 1uA
- Operation supply voltage range: 2.6 ~ 5.5V
- Operation temperature range: -40 ~ +85℃

2.2.6 LCD (HD44780):

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

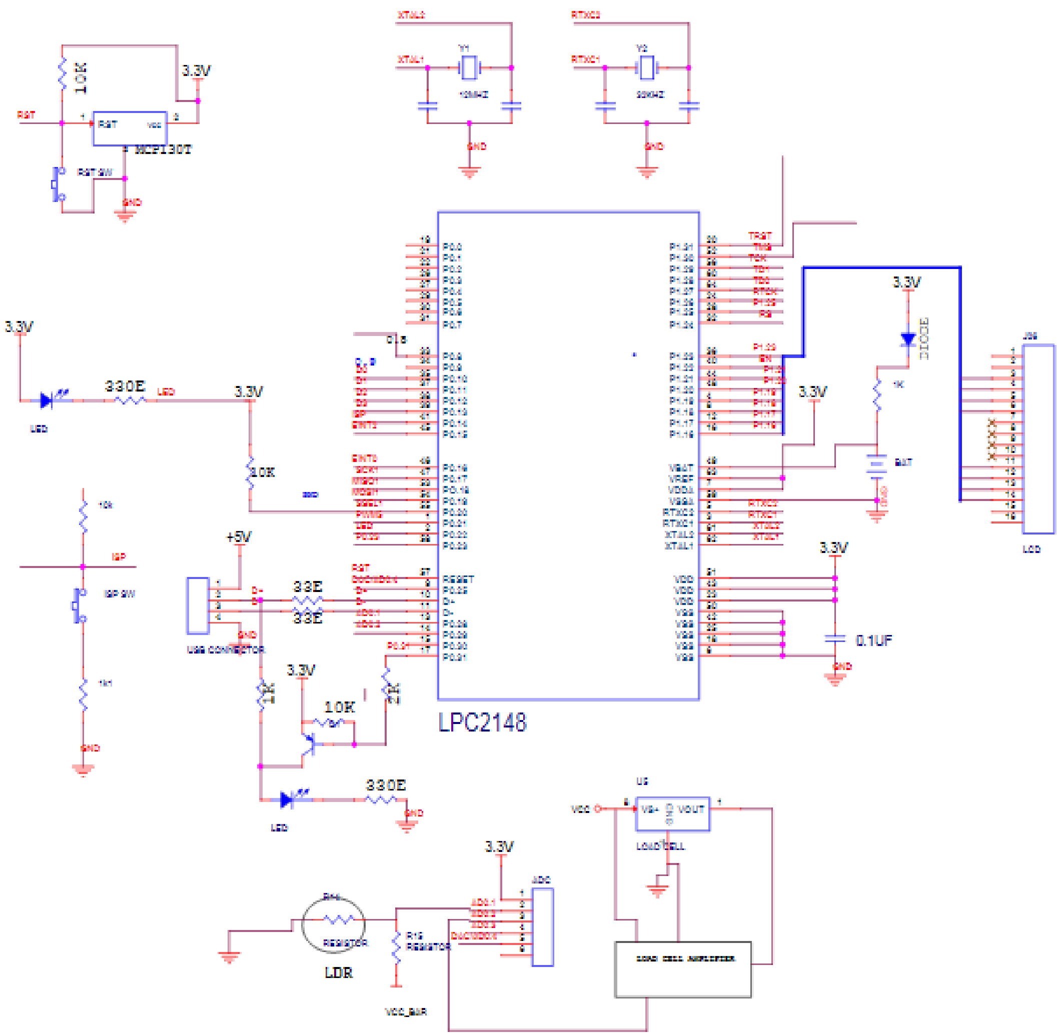

Fig 2.2. Schematic Diagram for Advanced Lactotester

2.3 Results & Analysis:

This project mainly consists of LPC2148 Microcontroller,Fat measuring module, Weight measuring module and an LCD display. The **fig 5.1** shows the section of Advanced Lactotester.

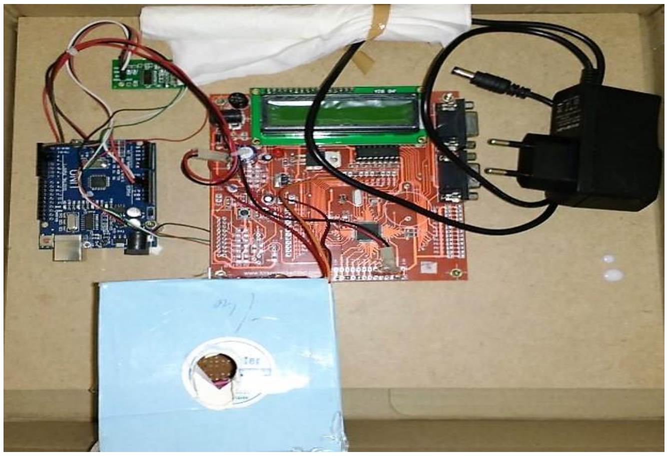

Figure 3.1: Project Test Setup of Advanced Lactotester

- First switch on the power supply, when we don't keep any milk sample in the closed setup, the board will detect and NO MILK will be displayed on the LCD display.

Figure 3.2: No Milk sample detected

- Now the test tube is filled with milk sample, and it will have inserted in the hole of closed setup, as shown in fig 3.3

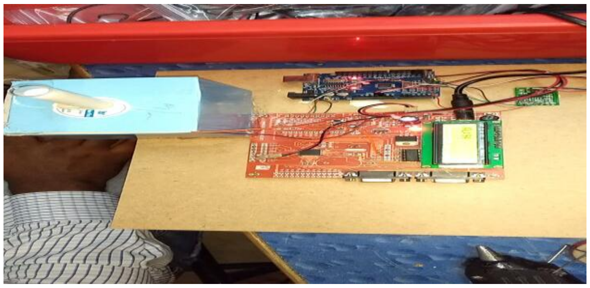

Figure 3.3: Inserting Milk Sample in Closed setup

- As soon as the milk sample is placed inside the closed setup, the fat measuring module and density measuring module will responds to change in surroundings inside the box.
- The test tube is placed in the hole provided, the led and ldr assembly present inside the closed setup will responds, the light coming from led will falls on test sample and fat molecules scatter

the amount of light according to density and ldr which is present at other end will gives the values of change in resistance as displayed on lcd display as shown in fig 3.4.

Figure 3.4: Fat value of Testing Sample

- The weight sensor present below the box setup will calculate the calibrated weight of the test sample and gives to HX711 and Arduino uno setup.
- As weight sensor is a low reduntant sensor the values should be amplified by the setup and given to the Arm7 Board.
- The specific weight of the sample will be displayed when the inputs received from the weight sensor as shown in fig 3.5.

Figure 3.5: Specfic Weight value of Testing sample

- Once the specific weight of milk sample is obtained, the conversions will be made in processor and remaining values will be displayed. The specific gravity of sample is displayed as shown in fig 3.6.

Figure 3.6: Specfic Gravity value of Testing sample

- Once we get the Specific Gravity value the Clr value will also be displayed as shown in fig 3.7.

Figure 3.7: CLR value of Testing sample

- As clr value and fat values are obtained, the SNF factor which is depends on both these values will also be calculated and displayed as shown in fig 3.8.

Figure 3.8: SNF value of Testing sample

Thus using our project, we can find various milk parameters of that testing sample at a time automatically.

3.1 CONCLUSION:

Milk industry takes the second largest economic share in India. Dairy farmers have been facing the issues with the present methods for testing the quality of milk and fixing the price according to the Dual Axis Pricing System. By this method, maintenance cost is quite high and there will be lot of wastage in milk in the process of segregation. Hence, our two substitute methods used in our project like led and ldr setup for Fat measurement and Weight sensor to find Clr values with an accuracy of 85% will overcome all issues and can be easily used by every dairy farmer. So that, he can find the quality of milk and make his own revenue without any other mediatory intervention