Faculty of Information Technology

University of Moratuwa

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Project Proposal

Level 1

Integrated Lab Supportive System

Group 36

Group Members

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Date of Submission: 2022/10/12

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INTRODUCTION

An Integrated Lab Supportive system can be introduced as a system bringing various lab instruments into a one system creating an all-in-one mini lab. Having different measuring instruments in a distance that can be reached by hand is the basic functionality of this system. It also supports different ways of taking measurements and observations in automated ways. Basically, providing one system for each user inside the chemistry laboratory is corresponding to a computer laboratory where each user having one computer. For general chemistry studies in schools and colleges having this type of system makes experimenting easier and user-friendly because system is made for user to be focused more on observation.

***Basically, for this project by the term ‘laboratory’ it is meant a general chemistry laboratory used in schools or colleges for general chemistry studies

PROBLEM IN BRIEF

While working in a chemical laboratory there are some difficulties that can be encountered. These different types of difficulties are considered one by one in brief below. Before starting, all needed equipment and tools must be gathered into the place where we work. Keeping them back one by one in sperate places is also another must.

Precision of measurements is a critical factor for a successful experiment. When using analog measuring equipment like traditional thermometers read value could differ compared to the shown value by the scale due to the observational error. Sometimes recognizing may be not perceivable for eye when expecting a gas (colorless) as a product of a chemical reaction or identifying almost similar colors of solutions apart.

Maintaining the sample around a constant temperature is another challenging task which is done by taking the burner in and out periodically in traditional laboratories. This is a slow process and attention is needed on the sample, which may be a tedious task while other observations about sample are supposed to be taken. Sometimes the temperature value being maintained could be exceeded because of this.

In the traditional way, experimental actions like reading the analog values, converting, recording, tabulating and graphing have to be done step by step manually which makes the evaluation of experiment harder and slower. In cases of having unexpected calculated results same process has to gone through by making adjustment and checking again and again. Process becomes even harder when two parameters need to be observed synchronously.

AIM & OBJECTIVES

Aim

Providing an all-in-one system (multifunctional equipment) that can achieve different tasks of different laboratory instruments, while helping to avoid difficulties of taking measurements.

Objectives

- Bringing all basic laboratory measuring and tasks into one unit reducing the time needed for reaching various instruments.
- Providing an automated functionality for gathering measurements for experiments needing consecutive measurements and observations.
- Providing real-time tabulating and graphing functionalities.
- Proving a way to take two measurement types simultaneously.
- Making the heating process easier, adjustable, measurable.
- Providing ability of maintaining a constant temperature for heating systems.
- Providing a way to recognize observations that are not perceivable for human eye. (Reactions with colorless gas releasing, precise color recognition)
- Making the experiment easier for user by making hands free of instruments as much as possible which also allows to be more focused on observation than handling instruments. (Automatic stirring mechanism)

  .

PROPOSED SOLUTION

For address every difficulty mentioned earlier an all-in-one integrated lab supportive system is proposed to be made. General description about the system and the way it deals with such difficulties is as follows.

This entire system consists four main sections.

- Automatic stirring arm and stand
- Digital display and controller panel
- Sensor probes rack
- Working board (included: heating unit, weight measuring unit)

Automatic stirring arm and stand

A motor is used which can give gentle motions to stir the solution in a test tube. A glass rod can also be placed stir a solution in a beaker kept below it.

A temperature sensor is positioned in a way that it contacts with surface of test tube to identify whether heat emitting(exothermic) or absorbing(endothermic) reaction is happening.

Digital display and controller panel

Selections and measurement data are displayed on an LCD graphical display. GUI menu is used for selections.

Temperature of a solution, pH value of a solution, weight of a sample and gas concentration (or gas detection), color of a solution are the main measurements handled by the system. Both single and dual channel measuring is available.

Two modes are available for measuring inputs as Direct and Period. In direct mode input is directly taken and value is displayed on screen. When measurements are needed to be gathered periodically Period mode can be used.

Heating system has two modes as Direct and Constant. Direct mode is a direct turning on and off while constant mode is used to keep the sample in a constant temperature.

Sensor probes rack

Temperature, pH, gas, color sensors are included as probes in a way that they can be dipped into a solution.

Addition to that there is a heating probe (made with copper coils) that can be attached to the bottom of test tube for supplying heat without using a Bunsen burner.

Working board

A heater plate is included that can be used for heating beakers and crucibles. This is turned off automatically after heating process is finished (when beaker is taken back) ensuring that there will be no burning damages.

Weight measuring plate sits next to heater plate. There is a functionality available with weight measuring unit that can remove the weight of the beaker from the total weight of sample which is useful for measuring the net weight. (taring)

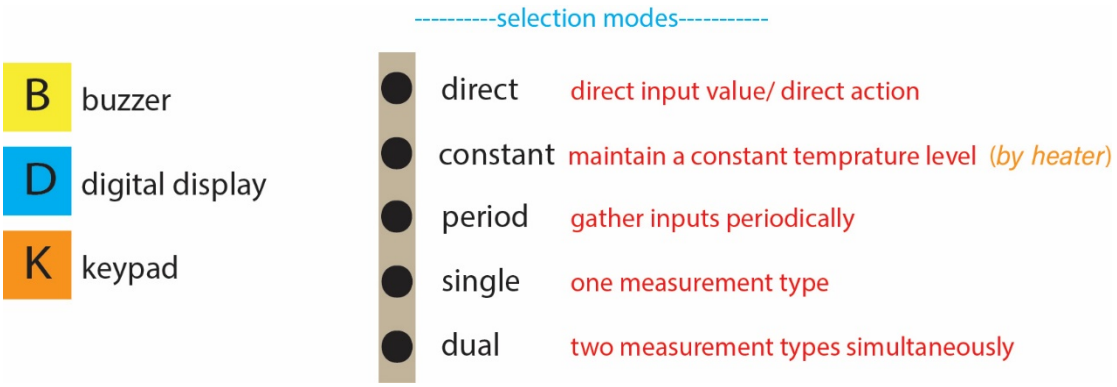
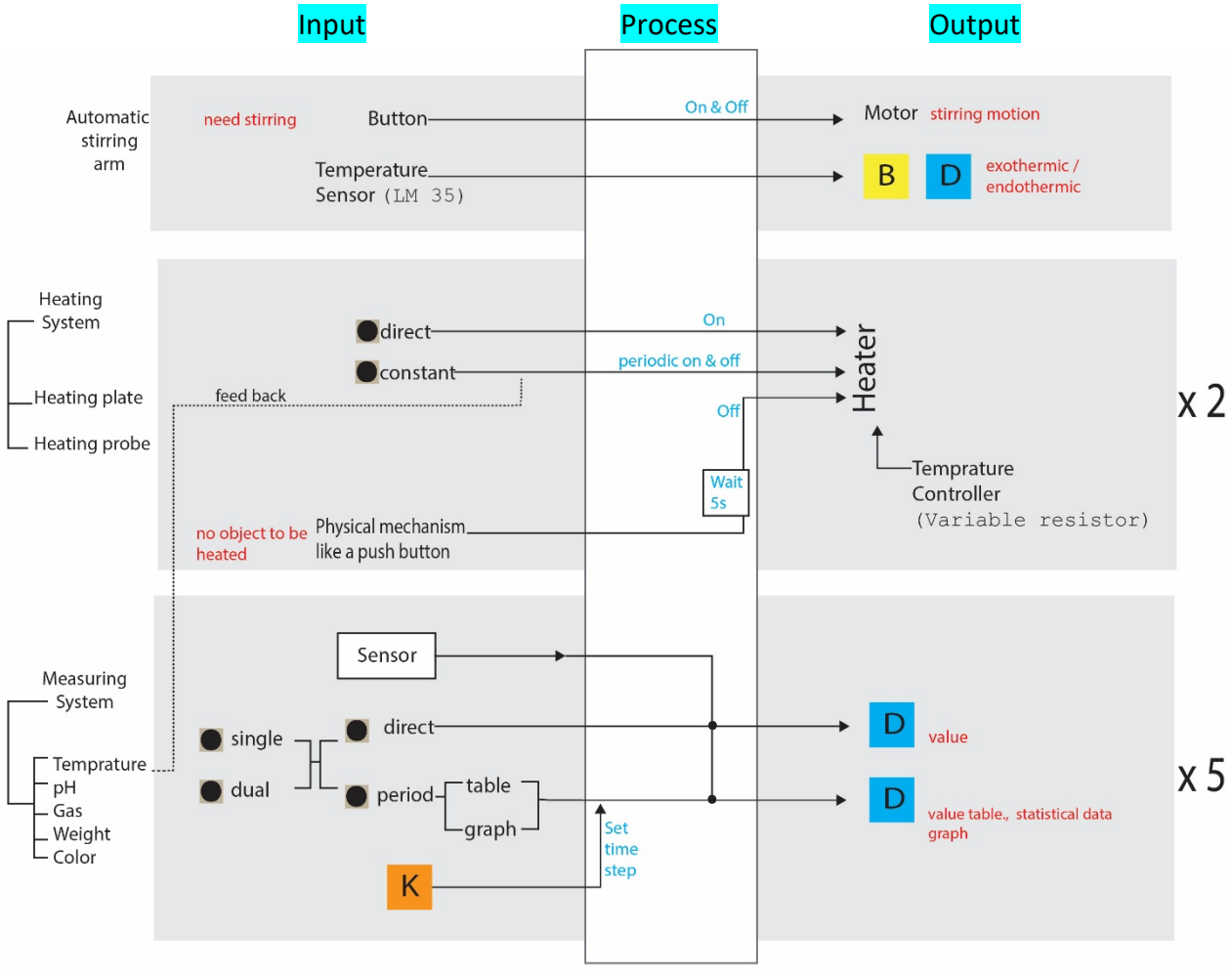


Figure 1- key for the block diagram



***Most of user inputs related to this sytem (option selection, turning on & off, numerical inputs) are given by a GUI menu*

Figure 2 - Block diagram of system functionality

RESOURCE REQUIREMENT

Hardware requirements

Table 1- resource requirement and estimation

Item	Quantity	Price per 1(Rs)	Total (Rs)
LM35 Temperature sensor	1	250	250
DS18B20 Temperature Sensor	1	600	600
pH sensor & BMC connector module	1	9000	9000
Gas sensor (MQ 8)	3	500	500
Load cell	2	900	900
HX711 load cell module	2	400	400
TCS230 color sensor	1	1000	1000
Arduino mega	1	6300	6300
Tft 1.8 display	1	2000	2000
SG-90 Servo motor	1	550	600
230v to 12v stepdown transformer	1	1500	1500
Gross estimation			Rs 22100

Software requirements

Atmel studio

REFERENCES

Introduction to microcontroller programming:

https://www.instructables.com/Getting-Started-With-the-ATMega328P/

https://www.allaboutcircuits.com/projects/breadboarding-and-programming-the-atmega328p-and-attiny45-in-atmel-studio-7/

https://circuitdigest.com/microcontroller-projects/portable-weighing-machine-using-arduino-and-hx711-weight-sensor-load-cell

Working with inputs(sensors) and outputs:

https://how2electronics.com/digital-thermometer-arduino-lm35-temperature-sensor/

https://how2electronics.com/industrial-thermometer-max6675-thermocouple-arduino/

https://circuitdigest.com/microcontroller-projects/arduino-ph-meter

https://circuitdigest.com/microcontroller-projects/interfacing-mq8-gas-sensor-with-arduino

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For price references:

https://www.duino.lk

https://www.tronik.lk

APPENDIX

Appendix A- action plan

Table 2- action plan

Part of the project	Responsible group member	Time needed
Automatic stirring arm, Color sensor probe	T.C.P. Bandara	10 months
Heating units	W.N.A.M. Abeysekara	10 months
pH probe, Temperature probe	M.P.S Fernando	10 months
Digital display and controller panel	W.M.D.M. Wijesinghe	10 months
Weight measuring unit, Gas Probe	G.T.J. Saranga	10 months