FORM 2

THE PATENT ACT 1970

(39 of 1970)

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The Patents Rules, 2003

COMPLETE SPECIFICATION

(See section 10 and rule 13)

1. TITLE OF THE INVENTION:

"THE AUTOMATED TITRATOR"

2. APPLICANT(S):

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3. PREAMBLE TO THE DESCRIPTION

The following specification particularly describes the invention and the manner in which it is to be performed.

4. DESCRIPTION:

FIELD OF INVENTION

The current invention is an automated titrator which is useful in the field of engineering chemistry as it helps in determining unknown concentration of an identified analyte. With technological innovations, the automation of titrator is made so as to make it simpler and precise in producing desired outcome. The invention also controls reaction conditions besides reducing the risk of human error. The embedded software tracks every variable of the experiment to ensure correct processing. The microcontroller involved in the system controls electric circuits while sensors detect change in the reaction in the real time thus resulting in an efficient output. While dealing with highly concentrated solutions, the automated titrator can be used to have high impact. In order to reduce delay in response time and minimize error, the invention has a knob fixed to a motor which is controlled by the microcontroller in response to a colour sensor. Thus, it accurately operates knob so as to avoid excess solution coming out of the burette and plays its role in producing expected output.

It has different components such as microcontroller, stepper motor, colour sensor and customised burette knob, a user interface which consists of a keypad and an LCD display which are used to take the user input and project the output or message to the user. There is common ground and bus for communication. Initially the user pipette's out the solution of known concentration the conical flask using a digital pipette and solution of unknown concentration is filled into the burette; appropriate indicator is added into the flask. The colour sensor isolation chamber is now closed and the magnetic stirrer is now turned on. The endpoint colour is given as an input to the automated titrator. The microcontroller in the automated titrator is the brainpower which takes the user input of end point colour needed, titrates the solution and precisely provides the end point.

BACKGROUND OF THE INVENTION

Titration, also known as titrimetry, is a common laboratory method of quantitative chemical analysis that is used to determine the unknown concentration of an identified analyte. Since volume measurements play a key role in titration, it is also known as volumetric analysis. A reagent, called the titrant or titrator, is prepared as a standard solution. A known concentration and volume of the titrant reacts with a solution of the analyte or titrand to determine concentration. The volume of the titrant reacted is called the titration volume. There are many types of titrations with different procedures and goals. The most common types of qualitative titration are acid-base titrations and redox titrations. Acid-Base titrations are usually used to find the amount of a known acidic or basic substance through acid base reactions. The analyte (titrand) is the solution with an unknown molarity. The reagent (titrant) is the solution with a known molarity that will react with the analyte. They depend on the neutralization between an acid and a base when mixed in solution. The acid-base indicator indicates the endpoint of the titration by changing colour.

In existing manual approaches used for titration, the burette knob is used to stop or continue the flow of a solution. As the knob needs to be closed as soon as it changes colour, there will be a delay in the response time and finally percentage of error will increase. This problem is solved with the current invention meant for automated titration where the knob is fixed to a motor which can be controlled by the microcontroller with respect to the colour sensor. As soon as the sensor detects the change in colour, the knob will be closed. Therefore, the movement of the knob will be accurate with which the excess solution does not come out of the burette. This indeed gives you the expected output.

OBJECTS OF THE INVENTION

1] Therefore, the object of the present invention is a technology driven automated titrator which is useful in determining unknown concentration of an identified analyte.

2] Another object of the present invention to have a colour sensor that plays crucial role in reaching convergence in the process of titration.

3] Another object of the present invention to have a microcontroller tailored for controlling the whole titration process right from taking inputs to producing error-free outputs.

4] Another important object of the present invention is to have an embedded software that drives the current invention and its components to work automatically to complete titration process.

5] Another important object of the present invention is to have a magnetic stirrer that relieves the user of stirring the flask and increasing the accuracy of the end point.

6] Another object of the present invention is to have a stepper motor equipped with burette knob for facilitating prevention of excess solution coming out of the burette.

7] Yet another object of the present invention is to provide a system to solve the problem of automatic titration which not only reduces error but also improves the accuracy of outcomes.

STATEMENT OF THE INVENTION

The present invention titled **"THE AUTOMATED TITRATOR"** is useful in the field of engineering chemistry as it helps in determining unknown concentration of an identified analyte. With technological innovations, the automation of titrator is made so as to make it simpler and precise in producing desired outcome. The invention also controls reaction conditions besides reducing the risk of human error. The embedded software tracks every variable of the experiment to ensure

correct processing. The microcontroller involved in the system controls electric circuits while sensors detect change in the reaction in the real time thus resulting in an efficient output. While dealing with highly concentrated solutions, the automated titrator can be used to have high impact. In order to reduce delay in response time and minimize error, the invention has a knob fixed to a motor which is controlled by the microcontroller in response to a colour sensor. Thus, it accurately operates knob so as to avoid excess solution coming out of the burette and plays its role in producing expected output.

The important components include microcontroller, matrix keypad, LCD display, colour sensor, stepper motor, stepper motor driver and power supply unit. LCD display is to provide appropriate messages. A custom designed knob is to hold the burette and stepper motor in place. The magnetic stirrer is an individual unit and runs in parallel to the microcontroller to relieve the user of stirring the flask and increasing the accuracy of the end point. The 3D printed colour sensor isolation chamber is a black box that's used to isolate the colour sensor from the ambient light. The microcontroller takes the user input of end point colour and colour intensity required. Then it uses the stepper motor to precisely flow in the solution from the burette into the flask, drop by drop. The colour sensor continuously detects for the output colour at the same time. Once the colour intensity is getting close to the desired colour the microcontroller increases the precision of the stepper motor which leads to decrease of solution flow. At the very instant the colour sensor senses the ideal colour the microcontroller uses the stepper motor to stop the titration and end point is achieved.

BRIEF DESCRIPTION OF THE DRAWING

The current invention is an automated titrator which is useful in the field of engineering chemistry as it helps in determining unknown concentration of an identified analyte. With technological innovations, the automation of titrator is made so as to make it simpler and precise in producing desired outcome. The invention also controls reaction conditions besides reducing the risk of human

error. The embedded software tracks every variable of the experiment to ensure correct processing. The microcontroller involved in the system controls electric circuits while sensors detect change in the reaction in the real time thus resulting in an efficient output. While dealing with highly concentrated solutions, the automated titrator can be used to have high impact. In order to reduce delay in response time and minimize error, the invention has a knob fixed to a motor which is controlled by the microcontroller in response to a colour sensor. Thus, it accurately operates knob so as to avoid excess solution coming out of the burette and plays its role in producing expected output. The current invention is illustrated with the help of many drawings given below.

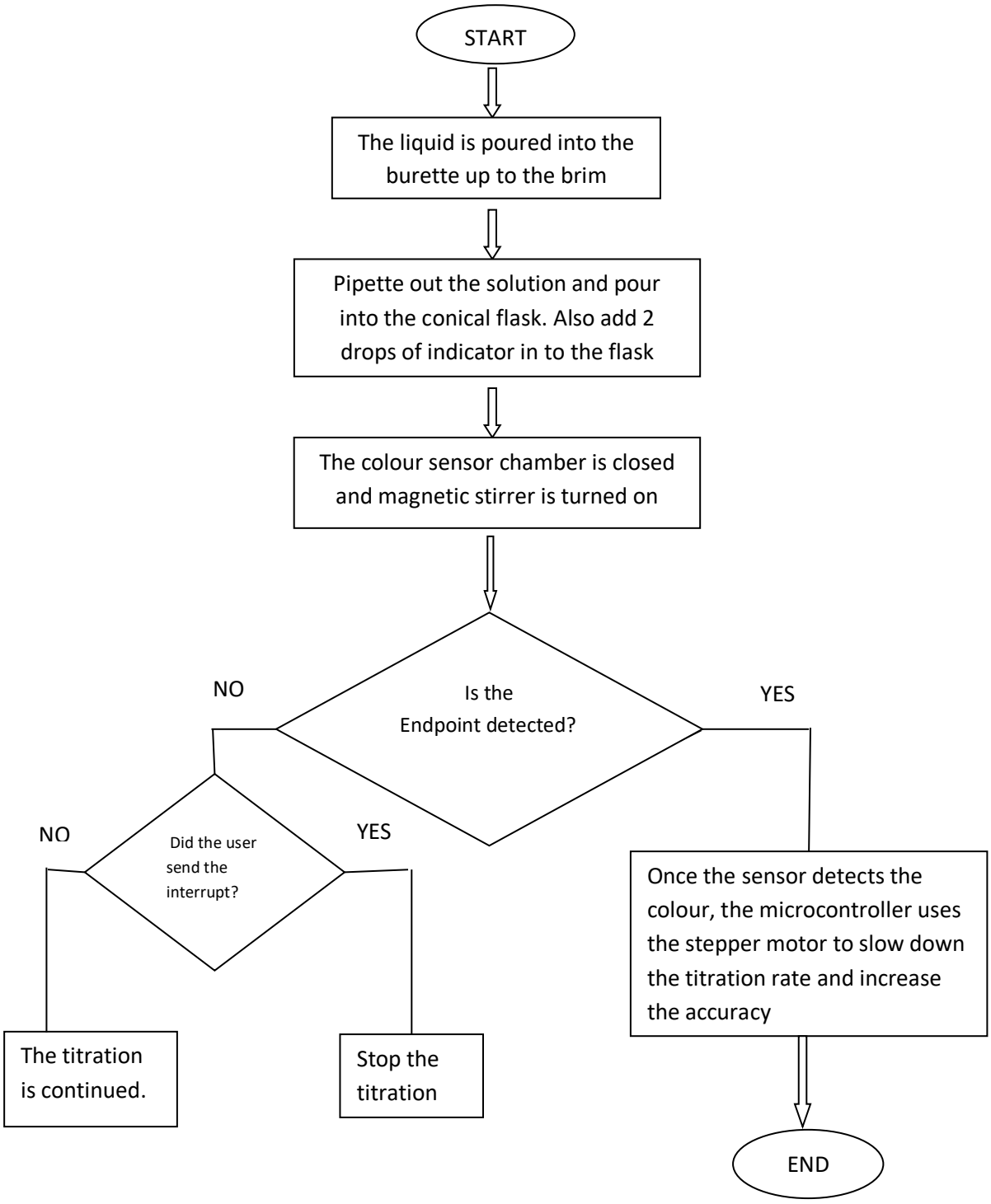

Figure 1: Illustrates the overview of the current invention with flowchart showing its modus operandi

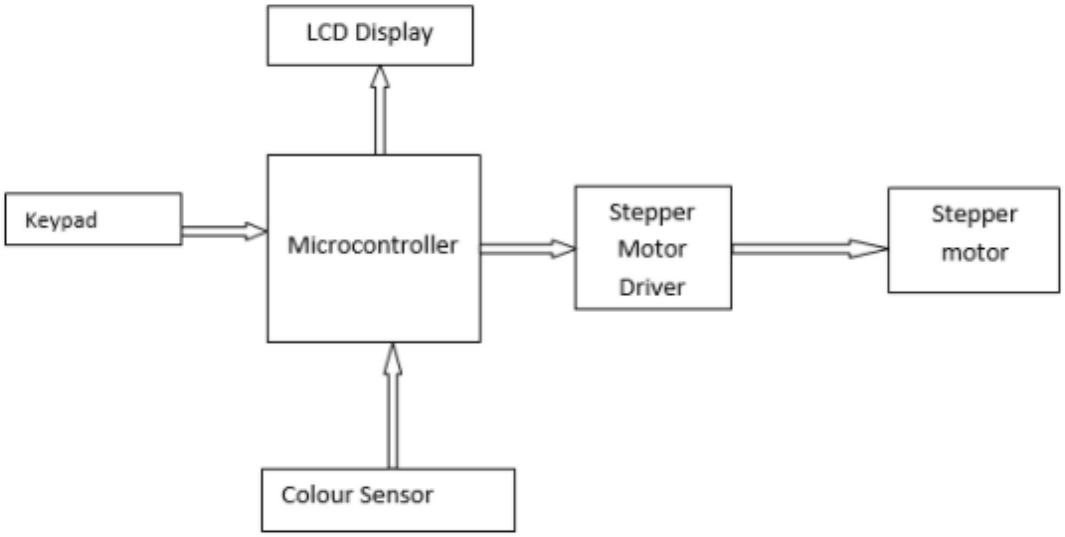

Figure 2: Illustrates the block diagram of the current invention known as automated titrator

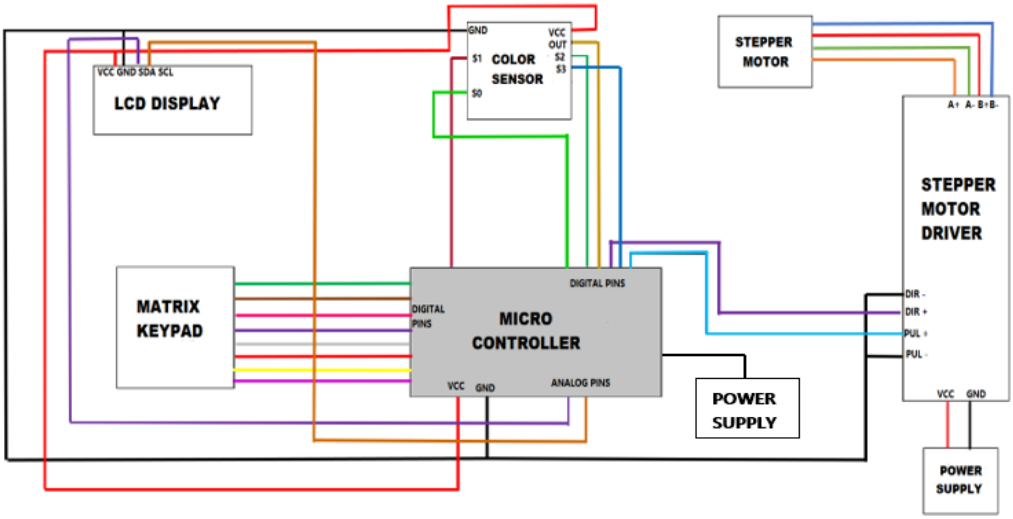

Figure 3: Illustrates the schematic diagram showing different components involved in the current invention

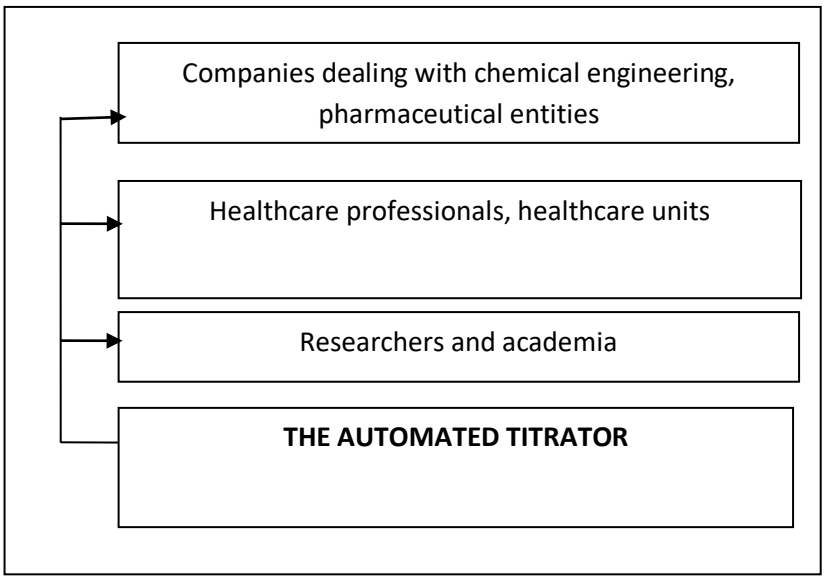

Figure 4: Stakeholders for which the invention is beneficial

DETAILED DESCRIPTION OF DRAWINGS

The current invention is an automated titrator which is useful in the field of engineering chemistry as it helps in determining unknown concentration of an identified analyte. With technological innovations, the automation of titrator is made so as to make it simpler and precise in producing desired outcome. The invention also controls reaction conditions besides reducing the risk of human error. The embedded software tracks every variable of the experiment to ensure correct processing. The microcontroller involved in the system controls electric circuits while sensors detect change in the reaction in the real time thus resulting in an efficient output. While dealing with highly concentrated solutions, the automated titrator can be used to have high impact. In order to reduce delay in response time and minimize error, the invention has a knob fixed to a motor which is controlled by the microcontroller in response to a colour sensor. Thus, it accurately operates knob so as to avoid excess solution coming out of the burette and plays its role in producing expected output. The diagrams provided in the previous section are described in detail in this section.

Referring to Figure 1, it illustrates the process flow of the current invention. A liquid is poured into the burette up to the brim. Then the solution is pipetted out and poured into the conical flask. Afterwards 2 drops of indicator are added to the flask. The colour sensor chamber is closed and magnetic stirrer is turned on. When the endpoint is not detected the titration is continued until it's detected or the user sends an interrupt. On the other hand, once the sensor detects the colour, the microcontroller uses the stepper motor to slow down the titration rate and increase the accuracy.

Referring to Figure 2, it illustrates the block diagram of the current invention meant for automated titration. It has different components such as microcontroller, stepper motor, colour sensor, customised burette knob, a user interface which consists of a keypad and an LCD display which are used to take the user input and project the output or message to the user. There is common ground and serial bus for communication. Initially the user pipette's out the solution of known concentration the conical flask using a digital pipette and solution of unknown concentration is filled into the burette; appropriate indicator is added into the flask. The colour sensor isolation chamber is now closed and the magnetic stirrer is now turned on. The endpoint colour is given as an input to the automated titrator. The micro--controller in the automated titrator is the brainpower which takes the user input of end point colour needed, titrates the solution and precisely provides the end point.

Referring to Figure 3, it illustrates the schematic diagram showing different components involved in the current invention. The important components include microcontroller, matrix keypad, LCD display, colour sensor, stepper motor, stepper motor driver and power supply unit. LCD display is to provide appropriate messages. A custom designed knob is to hold the burette and stepper motor in place. The magnetic stirrer is an individual unit and runs in parallel to the microcontroller to relieve the user of stirring the flask and increasing the accuracy of the end point. The 3D printed colour sensor isolation chamber is a black box

that’s used to isolate the colour sensor from the ambient light. The microcontroller takes the user input of end point colour and colour intensity required. Then it uses the stepper motor to precisely flow in the solution from the burette into the flask, drop by drop. The colour sensor continuously detects for the output colour at the same time. Once the colour intensity is getting close to the desired colour the microcontroller increases the precision of the stepper motor which leads to decrease of solution flow. At the very instant the colour sensor senses the ideal colour the microcontroller uses the stepper motor to stop the titration and end point is achieved.

Referring to Figure 4, it illustrates that the current invention is useful for different stakeholders. It is beneficial to companies dealing with chemical engineering, pharmaceutical entities, healthcare professionals and healthcare units besides researchers and academia.

5. CLAIMS

We Claim

1. A technology-driven automated titrator which is useful in determining unknown concentration of an identified analyte.

2. A colour sensor that plays crucial role in reaching convergence in the process of titration.

3. A microcontroller configured for controlling the whole titration process right from taking inputs to producing error-free outputs.

4. An embedded software that drives the current invention and its components to work automatically to complete titration process.

5. A magnetic stirrer that relieves the user of stirring the flask and increasing the accuracy of the end point.

6. A stepper motor equipped with burette knob for facilitating prevention of excess solution coming out of the burette.

7. A system to solve the problem of automatic titration which not only reduces error but also improves the accuracy of outcomes.

6. DATE AND SIGNATURE:

Dated this December 30, 2021

Authorized Patent Agent Signature: 

Authorized Patent Agent Name: **PUTTA GANESH**
(IN/PA/2933)

7. ABSTRACT

The current invention is an automated titrator which is useful in the field of engineering chemistry as it helps in determining unknown concentration of an identified analyte. With technological innovations, the automation of titrator is made so as to make it simpler and precise in producing desired outcome. The invention also controls reaction conditions besides reducing the risk of human error. The embedded software tracks every variable of the experiment to ensure correct processing. The microcontroller involved in the system controls electric circuits while sensors detect change in the reaction in the real time thus resulting in an efficient output. While dealing with highly concentrated solutions, the automated titrator can be used to have high impact. In order to reduce delay in response time and minimize error, the invention has a knob fixed to a motor which is controlled by the microcontroller in response to a colour sensor. Thus, it accurately operates knob so as to avoid excess solution coming out of the burette and plays its role in producing expected output. The automated titrator not only reduces error but also improves the accuracy of outcomes. The current invention is beneficial to many stakeholders such as companies dealing with chemical engineering, pharmaceutical entities, healthcare professionals and healthcare units besides researchers and academia.