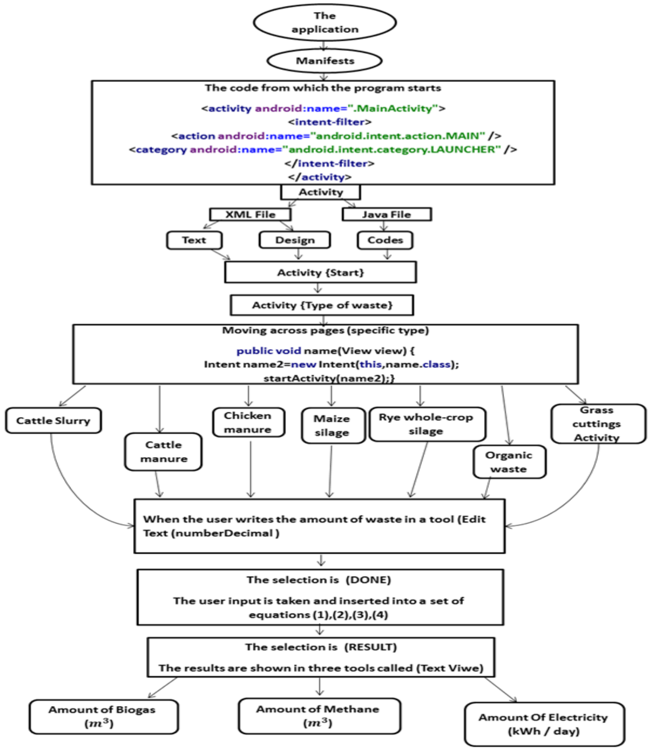
Algorithms

In the framework of the undergraduate course:
“Applied Mathematics”



```
<activity android:name=".MainActivity">
<intent-filter>
<action android:name="android.intent.action.MAIN" />
<category android:name="android.intent.category.LAUNCHER" />
</intent-filter>
</activity>
```

```
public void name(View view) {
Intent name2=new Intent(this,name.class);
startActivity(name2);}
```

When the user writes the amount of waste in a tool (Edit Text (numberDecimal)

The user input is taken and inserted into a set of equations (1),(2),(3),(4)

The results are shown in three tools called (Text Viwe)

Prof. Dr. Mohamed Samer
Engineering in Biosystems, Energy and Environment
Department of Agricultural Engineering
Faculty of Agriculture, Cairo University
E-Mails: msamer@agr.cu.edu.eg; samer@cu.edu.eg
Website: http://scholar.cu.edu.eg/samer/biocv

Introduction

In mathematics and computer science, an algorithm is a finite sequence of rigorous instructions, typically used to solve a class of specific problems or to perform a computation.

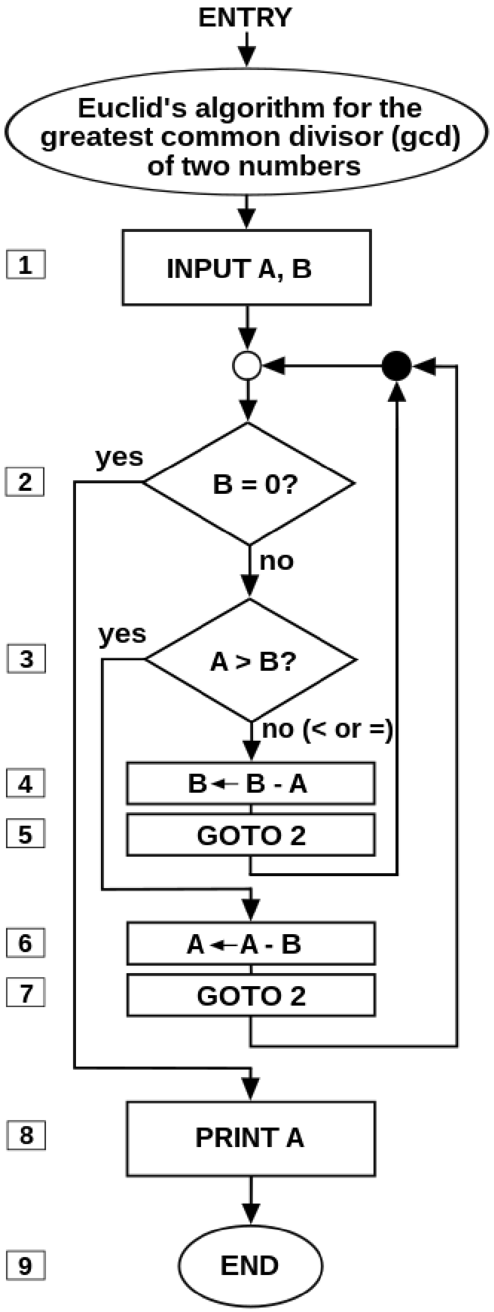
Algorithms are used as specifications for performing calculations and data processing. More advanced algorithms can perform automated deductions, i.e. reasoning, and use mathematical and logical tests to divert the code execution through various routes of automated decision-making.

Using human characteristics as descriptors of machines in metaphorical ways was already practiced by Alan Turing with terms such as "memory", "search" and "stimulus".

Algorithm can be expressed within a finite amount of space and time, and in a well-defined formal language for calculating a function.

Starting from an initial state and initial input (perhaps empty), the instructions describe a computation that, when executed, proceeds through a finite number of well-defined successive states, eventually producing "output" and terminating at a final ending state.

The transition from one state to the next is not necessarily deterministic; some algorithms, known as randomized algorithms, incorporate random input.


ENTRY
Euclid's algorithm for the greatest common divisor (gcd) of two numbers
1
INPUT A, B
2
yes
B = 0?
no
3
yes
A > B?
no (< or =)
4
B ← B - A
5
GOTO 2
6
A ← A - B
7
GOTO 2
8
PRINT A
9
END

Examples

Example 1

2.4. *Mathematical modeling*

The following equations were used to calculate the quantity of biogas, methane decomposition and the quantity of electricity produced by the amount of agricultural waste available from farmers.

$$E_{el} = 0.3 \times E_{overall} \qquad (1)$$

where

E_{el}: Electrical energy (kWh/day).
$E_{overall}$: Overall energy (kWh/day).

$$E_{overall} = V_{CH_4} \times 10 \qquad (2)$$

where

V_{CH_4}: Volume of methane yield (m^3).

10: conversion factor ($\frac{kwh}{day \times m^3}$)

$$V_{CH_4} = \frac{V_w \times HRT}{2.5} \qquad (3)$$

where

V_w:Volume of waste (m^3)

HRT: Hydraulic retention time (day).

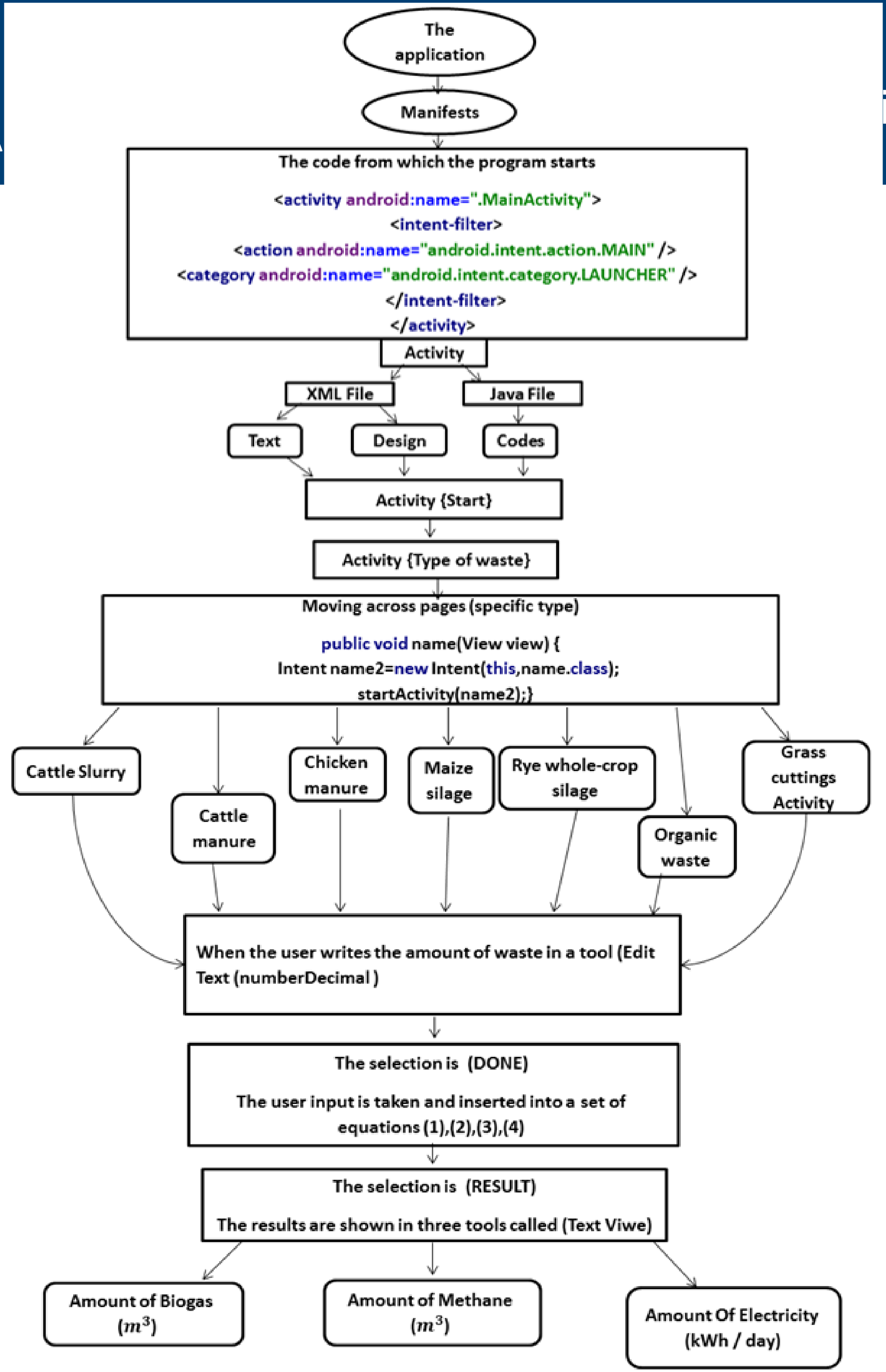
2.5: coefficient

$$V_{CH_4} = V_{biogas} \times X_{CH_4} \qquad (4)$$

where

V_{biogas}: Volume of biogas (m^3).

X_{CH_4} : Methane content (%).

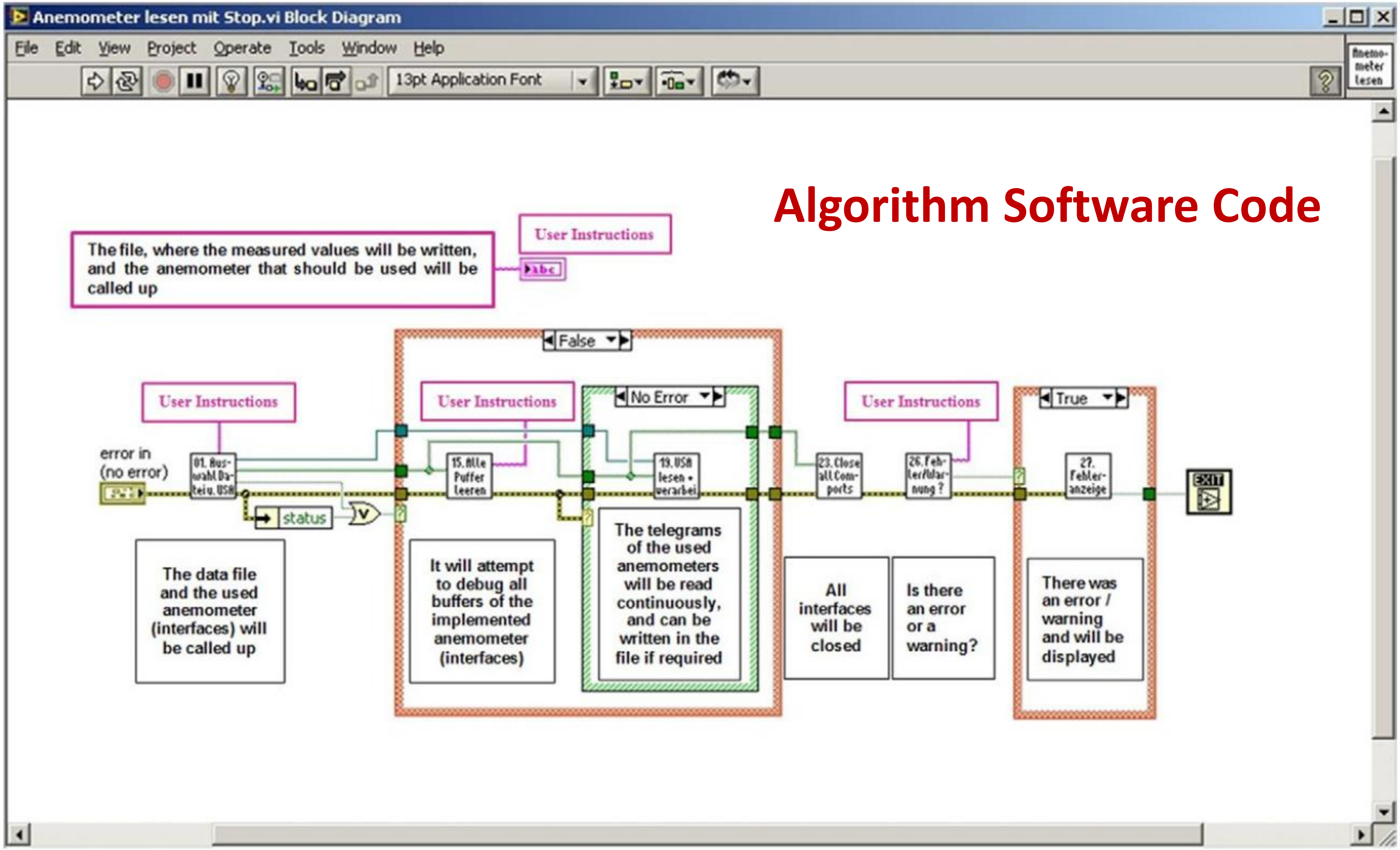


```
<activity android:name=".MainActivity">
<intent-filter>
<action android:name="android.intent.action.MAIN" />
<category android:name="android.intent.category.LAUNCHER" />
</intent-filter>
</activity>
```

```
public void name(View view) {
Intent name2=new Intent(this,name.class);
startActivity(name2);}
```

Example 2

Algorithm Software Code



The file, where the measured values will be written, and the anemometer that should be used will be called up

The data file and the used anemometer (interfaces) will be called up

It will attempt to debug all buffers of the implemented anemometer (interfaces)

The telegrams of the used anemometers will be read continuously, and can be written in the file if required

All interfaces will be closed

Is there an error or a warning?

There was an error / warning and will be displayed

Fig. 1. Block diagram of the configured software.

Algorithm Flowchart

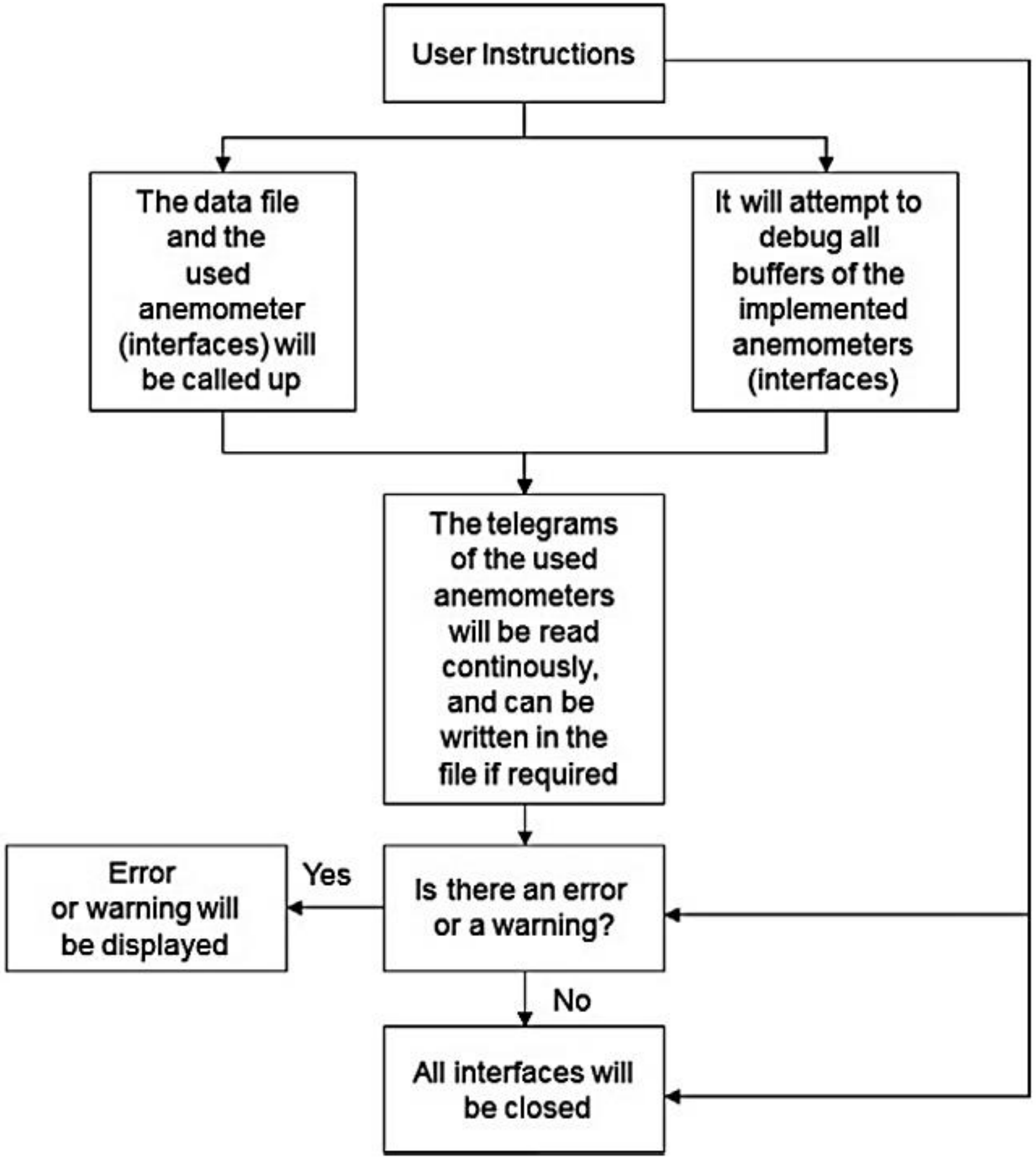


Fig. 2. A flowchart showing processes performed by the block diagram of the configured software.

Example 3

2.4. Mathematical modeling

2.4.1. Biobutanol calculations

2.4.1.1. Enzymatic saccharification rate

The enzymatic saccharification rate will be calculated as follows (Sasaki et al., 2014):

Enzymatic Saccharification Rate (%) =

$$\frac{\text{Amount of glucose produced (g)}}{\text{Amount of starch or cellulose and hemicellulose contained in each substrate}/0.9\,\text{(g)}} \times 100 \qquad (1)$$

2.4.1.2. ABE conversion rate

The acetone-butanol-ethanol (ABE) conversion rate will be calculated as follows (Sasaki et al., 2014):

$$\text{ABE conversion rate (\%)} = \frac{\text{amount of ABE produced}}{\text{theoretical maximum amount of ABE produced (0.362 g of ABE from 1 g of glucose)}} \times 100 \qquad (2)$$

2.4.1.3. Overall ABE production rate

The overall production rate (g L^{-1} h^{-1}) will be calculated as the maximum acetone-butanol-ethanol (ABE) concentration achieved (g L^{-1}) divided by the fermentation time (h). ABE Yield (g) will be calculated as the ABE concentration (g L^{-1}) in the fermented substrate multiplied by the volume of the fermented liquid substrate (L), where these calculations will be conducted as follows (Gao and Rehmann, 2014):

$$\text{Overall production rate}\,(\text{g L}^{-1}\ \text{h}^{-1}) = \frac{\text{Maximum ABE concentration (g L}^{-1})}{\text{Fermentation time (h)}} \tag{3}$$

$$\text{ABE Yield (g)} = \text{ABE Concentration (g L}^{-1}) \times \text{Substrate Volume (L)} \tag{4}$$


START
Total Bioethanol Produced (g/L)
Initial Dry Biomass Concentration (g/L)
Cellulose Fraction of Dry Biomass
Bioethanol Yield (%)
Ethanol Produced Concentration (g L-1)
Theoretical Ethanol Concentration (g L-1)
Bioconversion Rate (%)
Glucan Concentration (g L-1)
Xylan Concentration (g L-1)
Theoretical Bioethanol Concentration (g L-1)
Volume of Partially Purified Ethanol in Distillate (mL L-1)
Crude Ethanol in Fermentation Broth (mL L-1)
Purification Process Efficiency (%)
Display, Save, Retrieve, …etc.

2.4.2.1. Bioethanol yield

The bioethanol yield (%) will be calculated as follows (Kang et al., 2015; Singhania et al., 2014):

$$\text{Ethanol yield} = [(\text{EtOH}_f - \text{EtOH}_0)/(0.511 * f * [\text{Biomass}]_0 * 1.111)] * 100\% \qquad (5)$$

where, $\{\text{EtOH}_f - \text{EtOH}_0\}$ indicates total bioethanol produced during fermentation (g/L) run, $[\text{Biomass}]_0$ is the initial dry biomass concentration (g/L), *f* is cellulose fraction of dry biomass, 0.511 is the conversion factor for glucose to bioethanol based on stoichiometric biochemistry of yeast and 1.111 is the conversion factor for cellulose to equivalent glucose.

2.4.2.2. Bioconversion rate

The bioconversion rate (%) will be determined as following (Khuong et al., 2014):

$$\text{Conversion rate}(\%) = \frac{\text{Ethanol produced concentration g L}^{-1}}{\text{Theoretical ethanol concentration g L}^{-1}} \times 100 \qquad (6)$$

The theoretical bioethanol concentration (g L^{-1}) will be calculated as follows (Khuong et al., 2014):

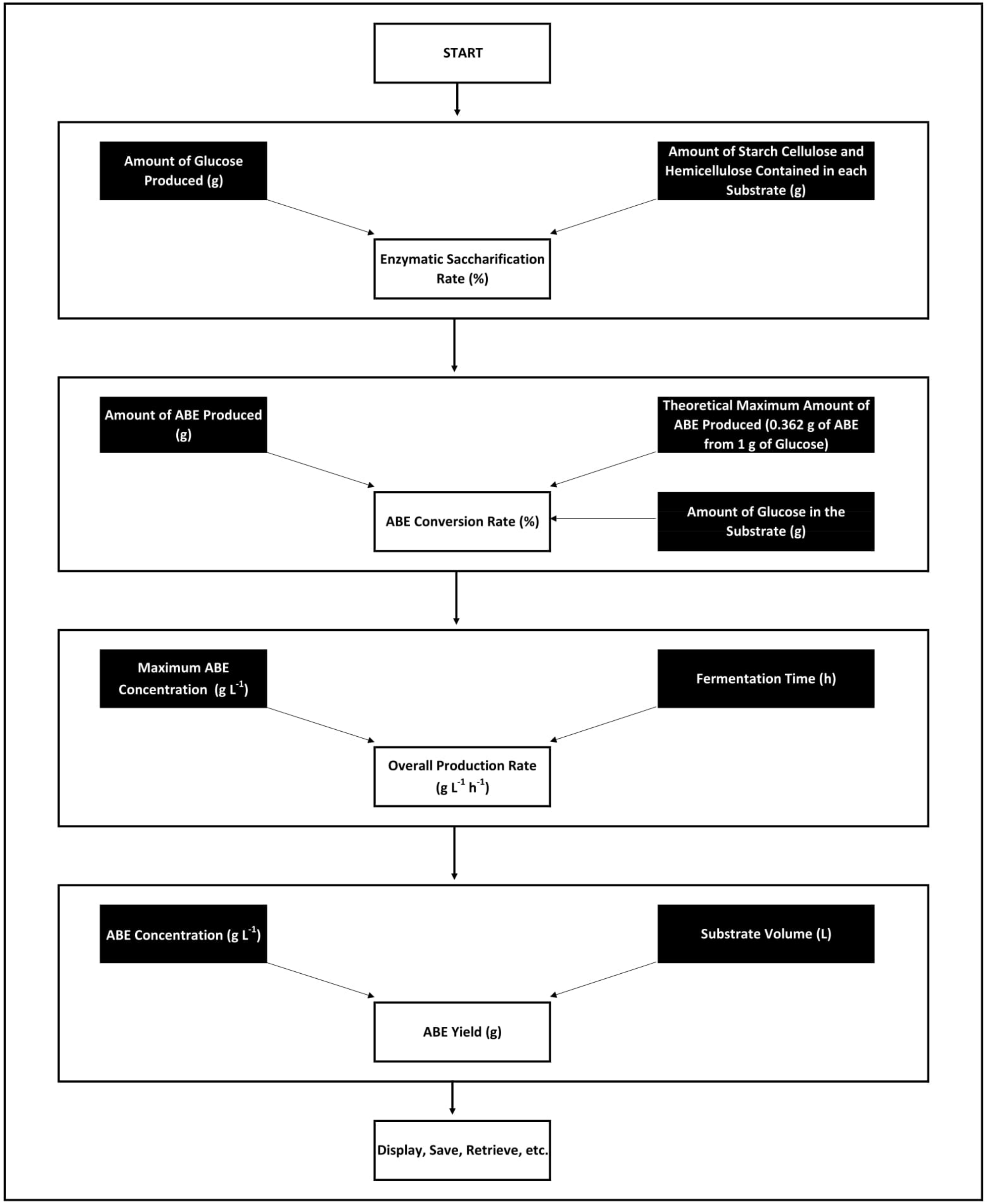
$$\begin{aligned}&\text{Theoretical ethanol concentration g L}^{-1}\\&\quad = \text{Glucan concentration} \times 1.1 \times 0.51\\&\qquad + \text{Xylan concentration} \times 1.14 \times 0.46\end{aligned} \tag{7}$$

where, 1.11 is the coefficient of glucose obtained from glucan, 1.14 is the coefficient of xylose obtained from xylan (Sluiter et al., 2008); 0.51 is the coefficient of ethanol obtained from glucose, and 0.46 is the coefficient of ethanol obtained from xylose (Aita et al., 2011).

2.4.2.3. Purification process efficiency

The purification process efficiency of bioethanol obtained by distillation will be calculated using the following equation (Das et al., 2013; Gupta et al., 2014):

$$\text{purification process efficiency } (\%) = \frac{\text{volume of partially purified ethanol in distillate (mL/L)}}{\text{crude ethanol in fermentation broth (mL/L)}} \times 100 \tag{8}$$



START

Amount of Glucose Produced (g)

Amount of Starch Cellulose and Hemicellulose Contained in each Substrate (g)

Enzymatic Saccharification Rate (%)

Amount of ABE Produced (g)

Theoretical Maximum Amount of ABE Produced (0.362 g of ABE from 1 g of Glucose)

Amount of Glucose in the Substrate (g)

ABE Conversion Rate (%)

Maximum ABE Concentration (g L^{-1})

Fermentation Time (h)

Overall Production Rate (g L^{-1} h^{-1})

ABE Concentration (g L^{-1})

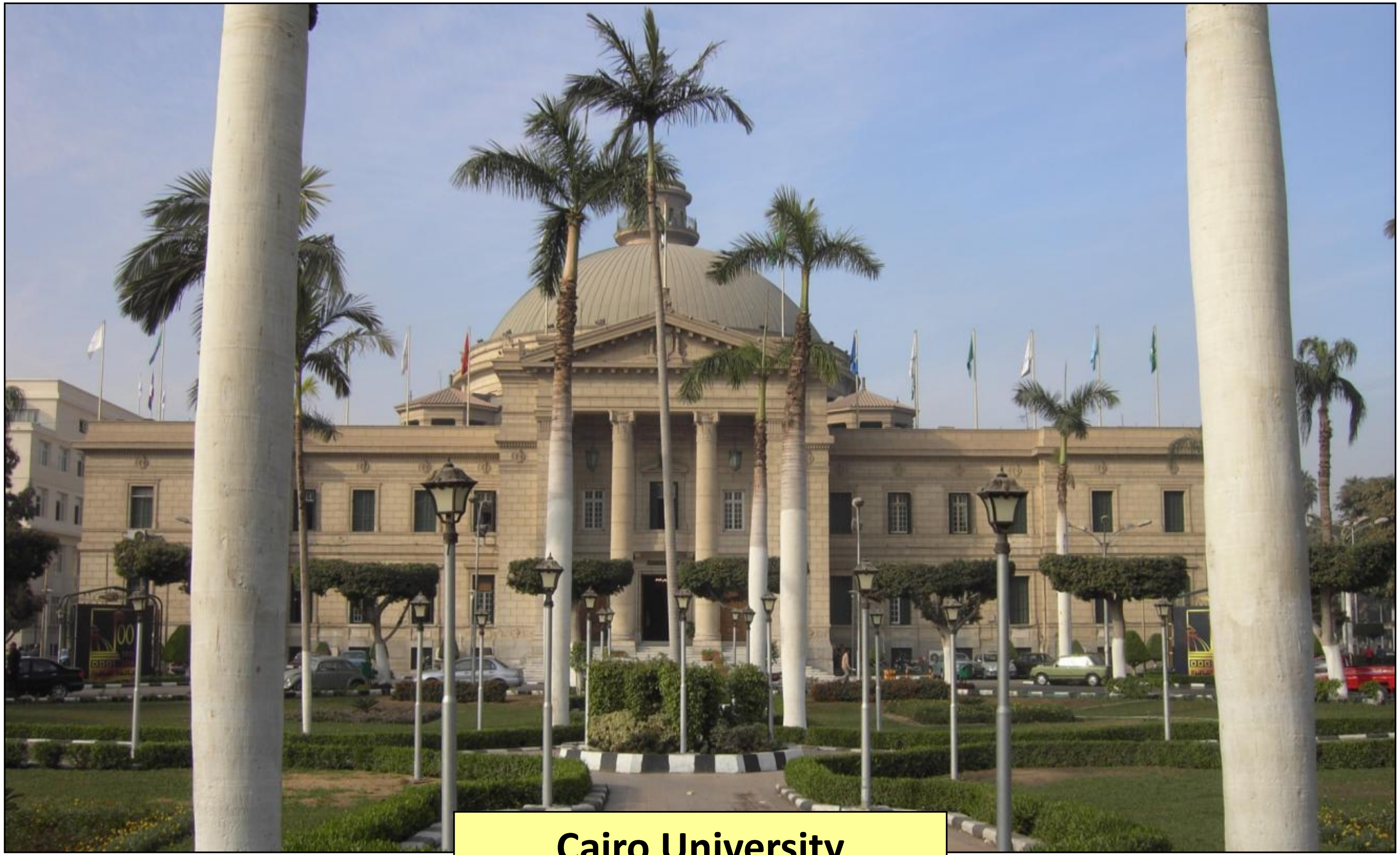
Substrate Volume (L)

ABE Yield (g)

Display, Save, Retrieve, etc.

Further Examples and Applications

Thank You!



Cairo University