

**DEVELOPMENT OF SOLAR BASED WATER CIRCULATION MACHINE  
FOR UTeM LAKE.**

**MUHAMMAD AMIRUL ASYHRAF BIN AB.RAZAK**

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**APPROVAL**

“I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Mechanical Engineering (Plant And Maintenance).”

Signature: .....

Supervisor' Name: DR. MOHD KHAIRI BIN MOHAMED NOR

Date: .....

## DECLARATION

“I hereby admit that this report is all written by me except for the summary and the article  
which I have stated the source for each of them”

Signature : .....

Writer : .....

Date : .....

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## **ABSTRACT**

Lake UTeM has long been prohibited for water sports activities since 2012. This is because the lake was contaminated and as a precautionary measure, UTeM has banned citizens from using the lake UTeM for any activity. The aim of this project is to produce a solar based water circulation machine for UTeM Lake. In this study, the design of these machines has been performed. Studies on the parts and components that are important for this engine also have been done to produce a design for solar based water circulation machine. Selection of the design based on the objectives and key features. Selection of the design was selected by using the Morphological and Pugh Chart Method. Then, the calculation on solar panel, paddle wheel and the stability of the boat were done. It is really help in understanding on how boat is made from the design, calculation and builds it. Lastly, the prototype achieve the objective and for sure still not perfect but it is functioning well on water.

## ABSTRAK

Tasik UTeM telah lama dilarang untuk aktiviti sukan air sejak tahun 2012. Hal ini kerana, tasik tersebut telah tercemar dan sebagai langkah berjaga-jaga, UTeM telah melarang warga UTeM dari menggunakan tasik UTeM untuk sebarang aktiviti. Tujuan projek ini adalah untuk menghasilkan satu mesin peredaran air yang berasaskan solar untuk tasik UTeM. Dalam kajian ini, penghasilan reka bentuk untuk mesin ini telah dijalankan. Kajian ke atas bahagian dan komponen yang penting untuk mesin ini juga telah di lakukan bagi menghasilkan reka bentuk untuk mesin peredaran air yang berasaskan solar. Pemilihan reka bentuk berdasarkan objektif dan ciri-ciri yang penting. Pemilihan reka bentuk di pilih dengan menggunakan cara Morphological Chart dan Pugh Method. Seterusnya, pengiraan bagi panel suria, roda dayung dan keseimbangan sampan telah dijalankan. Ia benar-benar membantu dalam memahami bagaimana bot dibuat dari reka bentuk, pengiraan dan pembuatan. Akhir sekali, prototaip mencapai objektif kajian dan semestinya masih tidak sempurna tetapi ia berfungsi dengan baik di atas air.

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## **CHAPTER I**

### **INTRODUCTION**

#### **1.0 INTRODUCTION**

Leptospirosis epidemic by bacteria called leptospira. In the developed world it most commonly occurs in those involved in outdoor activities in warm and wet areas of the world. UTeM Lake has been banned for water activities because of a problem on Leptospirosis. This is because the lake have no water circulating system that can make water flowing.

The main reason to develop this solar based water circulation machine is to create the motion on the water in the lake to prevent from leptospira spread in the lake. We use the concept of paddle wheel to make the water move. In order to do that, the water must be flowing frequently so that the polluted water will flow around the lake.

Thus, the aim of this project is to come up a design like a boat that can make the water in the lake flowing especially at the close banks area that going to be powered by solar and battery. The result will provide vital information about the design of a water circulation machine that can move autonomously the UTeM Lake.

## 1.1 PROBLEM STATEMENT

Water sport was once a main activity in UTeM. This is because, UTeM have 3 lakes with big scale and become one of the advantage in UTeM for doing sport like rowing. UTeM lake have weak water circulation system that can make the water flow. This problem can cause Leptospirosis so the water activity on UTeM Lake has been banned. However, there is effort to prevent this problem by putting water fountain at the center of the lake. But the area cover is not enough to make the water at the lakeside to flow. Since 2012, the lake has been band for water activity because were polluted by Leptospirosis. It take one and half years for the responsible company that doing research, investigation and water recovery to give feedback about the condition of the lake. Although the feedback was positive, UTeM take a precaution step to hold the lake from being used for water activity.



Figure 1.1 Tasik B UTeM



Figure 1.2: Area of the lake bank

## **1.2 OBJECTIVE**

The objectives of this project are as follows:

1. To create a water flow around the lakeside of UTeM lake by using autonomous water circulation machine.
2. To calculate the stability of the water circulation machine.

## **1.3 SCOPE OF PROJECT**

The scopes of this project are:

1. Identify the suitable solution to make the wave on water
2. Proposed the design specifications
3. Analysis on the proposed design



## 1.4 GENERAL METHODOLOGY

The actions that need to be carried out to achieve the objectives in this project are listed below:

1. Literature review

Journals, articles or any materials regarding the project will be review.

2. Planning

Planning on size of the boat, mechanism, and suitable concept of boat .

3. Calculation

Calculate the power use and the wave can it make based on the planning.

4. Choosing design

The design will be a mechanism that can make a wave and the material need to be light.

5. Analysis and proposed solution

Analysis will be presented on how we can make it high efficiency and solve the problem. Solution will be proposed based on the analysis.

6. Fabricate

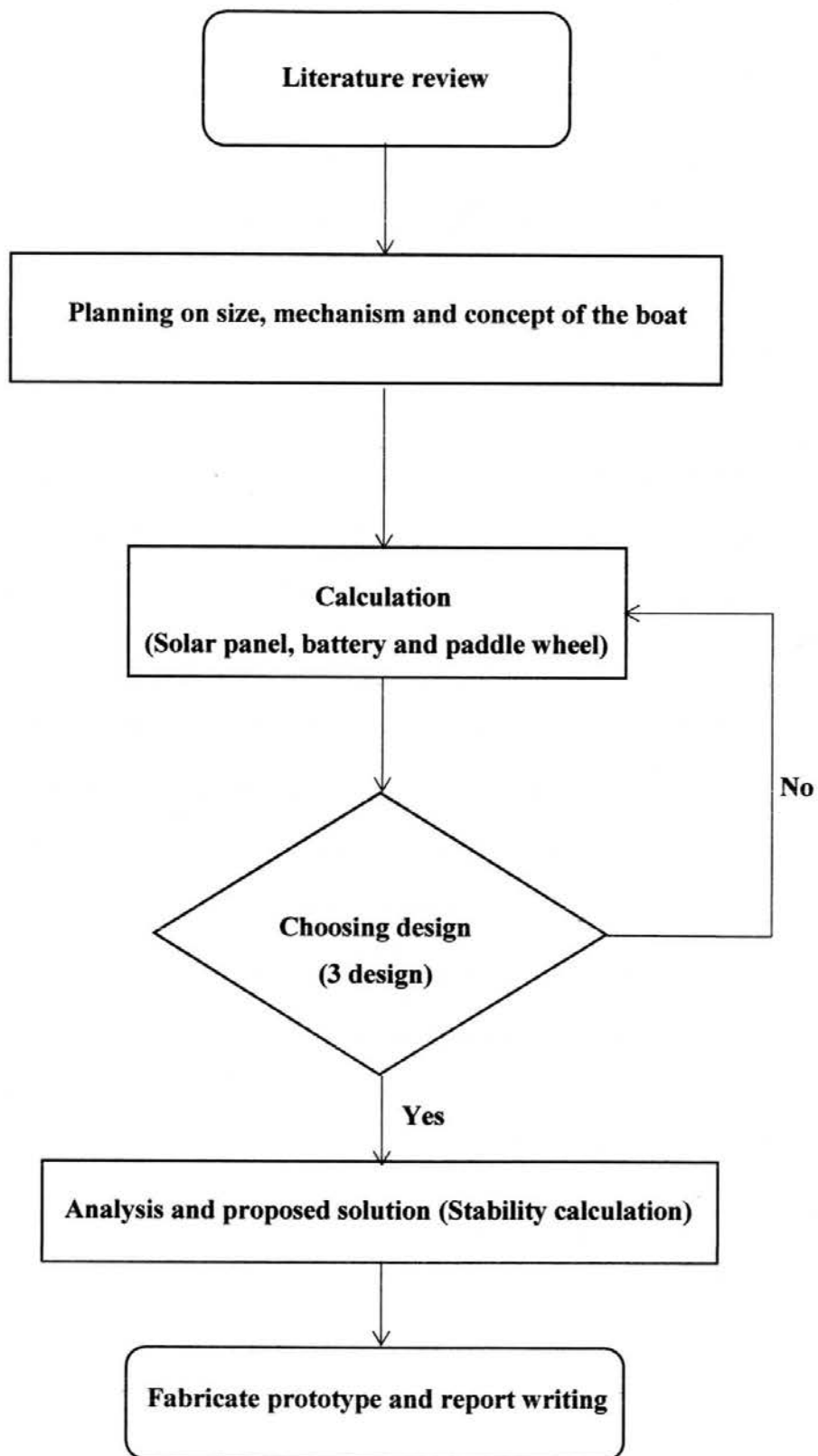
Fabricate the prototype to complete the result.

7. Report writing

Report on this study will be written at the end of this study.

The methodology of this study is summarized in the flow chart as shown below

### 1.5 FLOW CHART



## **CHAPTER II**

### **LITERATURE REVIEW**

#### **2.0 INTRODUCTION**

This chapter will explain about the type of the design and the component that will be used to create a water circulation machine. Furthermore, explaining about the mechanism used in the circuit component will be more detailed. An autonomous solar boat is a machine that uses the sun to charge and store batteries that supply power to the motor. Basically, this water circulation machine is a new development product. It is actually just like the other boats that we always see but unlike a normal boat it doesn't have a pilot and can keep traveling as long as there is energy stored on its batteries. An autonomous solar boat can travel while the charges that have been stored in batteries are still available. The charge comes from the natural source which is the sun that directly emits it to the solar panel. After that, the solar panel which has photovoltaic cells converts it to electricity. The electricity is used for the motor to move the boat and to supply power to the autonomous microcontroller.

## 2.1 SOLAR POWER

Solar energy is one of the alternative energy that can be renewable, not all country can use this energy efficiently because of their environment and weather. Solar energy can produce heat energy or can be converted to electric energy using a silicon-based photovoltaic or PV panel. In Solar Thermal, solar energy usually use for heating fluid or air to converted to water or space heating. In order the solar energy to be converted to electric energy, first the solar energy from the sunlight received by the solar panel to charge the battery. Next, the battery provides DC voltage but usually the motor is AC motor, so the voltage from battery must go to the inverter. The inverter functions as to converted DC voltage to AC voltage. The unit commonly used for solar penal powers output is watts (W) and the formula is:-

$$\text{Watt (W)} = \text{Voltage (V)} \times \text{Ampere (A)} \quad 2.1$$

Solar boat is an interesting development that has been improves by electric boat. It is invented to reduce the environment problem and uses green technology. Besides that, it has clean engines, independent and the batteries energy is store from the free source sun. Solar electricity is very reliable, durable and the prices is kept going down due to improving of technologies.

## 2.2 ELECTRIC BOAT HISTORY

Electric boat history can be separate into several decade ages which start from early, golden age, decline, renaissance and this technology era. German inventor Moritz von Jacobi (1839) developed an electric boat that have 25 foot diameter long and can carry 14 passengers. The electric boat is successfully travel and demonstrated to Emperor Nicholas I of Russia on the Nera River at 3 mph speed. After about 30 years, battery and motor have been found and this makes electric boat become famous. In 1880 a small electric motor has been patented by Gustave Trouve, French electrical engineer. At first he suggested that motor can be powered by paddle wheels but then he use propeller.

While in Britain, Power Storage Company engineer, Anthony Reckenzuan, develop the first practical boats which driven by storage batteries. Anthony Reckenzuan then names it Electricity. Electricity can run for six hours and can travel 8 miles per hour. After that, in 1882 one company was established to be specialized to electric motors in transportation. They make a very first practical electric boat with electric charging stations.

Basically electric boat was famous around 1890 to 1920 just before the combustion engine was developed and this golden era just creates a small passenger boats. Right after the combustion engine was invented the electric boats become a non-famous thing but in several cases they still use this electric system. On the renaissance era Duffy Electric Boat Company has produced a lot of electric boat, and then solar boat starts to spread widely.

### 2.3 PADDLE WHEEL

The paddle wheel has been used as marine propulsion for more than two hundred years, but it has been developed little for the last one hundred years. It could be concluded that as a means of efficient propulsion for today's marine vessel by paddle has stagnated and the possibility that paddle propulsion could find applications not yet been considered same with the maximum potential that the paddle can reach. Meanwhile, it still has the potential to be used for paddling a medium speed craft or perhaps can be used for a craft that does not need to move at high speed. For example fishing boat, river cleaning boat and boat that were used in a pond or lake.

The work of Volpich and Bridge (1955) represents the experimental results for paddle wheel of significant scale. The size of 1.04m (3.4 ft) diameter of the wheel been tested in the experiment tank but the authors only present one plot of raw data of thrust against both paddle rpm and advance velocity ( $V_a$ ) even though the experiment were detailed. The graph present thrust values for paddle rpm's from 0 to 100 rpm with a range from 0 to 4.6 m/s in 0.508 m/s of advance velocities. The result was fixed in terms of the number of blades and paddle immersion or floats. Torque coefficient was presented, but no raw experimental results were presented for torque. The results were replotted in non-dimensional format by using coefficients used for cycloidal propulsions (Bose 2008) even through all the results presented are dimensional.

Paddle wheel can be calculated:

$$K_T = \frac{T}{A\rho\Omega^2 R^2} \quad 2.2$$

where  $T$  is thrust (N);  $A$  is wetted surface area (m<sup>2</sup>);  $\rho$  is density (kg/m<sup>3</sup>);  $\Omega$  is paddle rotational speed (rad/s);  $R$  is radius of paddle (m).

$$K_Q = \frac{Q}{A\rho\Omega^2 R^3} \quad 2.3$$

where  $Q$  is torque (N.m).

$$J = \frac{V_a \pi}{\Omega R} \quad 2.4$$

where  $V_a$  is vessel speed (knots).

$$\eta = \frac{K_T J}{K_Q \pi} \quad 2.5$$

where  $\eta$  is efficiency;  $K_T$  is thrust coefficient;  $K_Q$  is torque coefficient;  $J$  is advance coefficient.

### 2.3.1 Paddle wheel (Power) calculations

In an undershot wheel or a run of the river wheel the power is dependent to the kinetic energy of the river. Approximate power can be calculated;

$$\text{Power in Watts} = 100 \times A \times V^3 \times C \quad 2.6$$

$A$  = Area of paddles in the water (square meters)

$V$  = Velocity of the stream in meters per second

$C$  = Efficiency Constant

Rotational speed of the wheel =  $9 \times V / D$  rpm

$D$  = diameter in meters