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EMERGENCY AUTOMATED HYDRAULIC PATHWAY

John Paul B. Lomibao[1], Jessa P. Ornopia[2], Engr. Marion Depalubos IV[3]

College of Engineering, Computer Studies and Architecture,
Lyceum of the Philippine University – Cavite, General Trias City, Cavite, Philippines

***Abstract*. The purpose of this study is to design and provide a pathway that will automatically operate when there is flood in a certain area where the prototype is placed, to help and provide convenience to the people that will pass by in the area. It is a closed loop system and fully automated device, which is composed of power source, water level sensor, floater valve, limit switches for up and down movements hydraulic motor with another two limit switches, hydraulic hoses, hydraulic cylinder and the pathway. The limitation of the study is that the load that the system can withstand is limited to one two persons in one are at the same time. It is recommended that in the inclusion of environmental measures, one to be considered is to seal the oil tank, hydraulic hose and the hydraulic cylinder to avoid the leaking and the engagement of the hydraulic oil into the flood water and to install an alarm or buzzer so that the people will be advised that the system is elevating or depreciating.**

***Keywords*: emergency, automated hydraulic pathway, elevate, hydraulics.**

I. INTRODUCTION

Floods have large social consequences for communities and individuals. As most people are well aware, the immediate impacts of flooding include loss of human life, damage to property, destruction of crops, loss of livestock, and deterioration of health conditions owing to waterborne diseases.

The study was undertaken to provide engineering solution in a certain area that has an uncontrolled problem, which is flood, produced by continuous rainfall. The main goal of the study is to design and construct an elevated pathway using hydraulic system, which automatically operates when flood is detected by the sensor. Hydraulic system refers to a mechanism operated by the pressure transmitted when a liquid is forced through a small opening or tube. It has also a wide scale use of applicability in technologically driven industrial manufacturing processes, making it a good choice of mechanism for the assembly of Emergency Automated Hydraulic Pathway. Another aim of the study is to design the materials needed in the construction of the device considering its resistance involving the different substances that floodwater carries. The scope of the study focuses only on the design of the hydraulic pathway up to the development of the system on how this device will work properly. The expected location that the prototype will serve is one straight distance only.

This study will help many people on avoiding the contaminants carried by the flood that may cause diseases, damage of their electronic devices and other personal things and can bring convenience to the people who will use it.

II. LITERATURE REVIEW

The design of the automated hydraulic pathway consists of an actuator, hydraulic pump, linkage system, a platform and an electronic equipment. For to be able to design, a sound knowledge of under courses in basic electronics, control system engineering, fluid mechanics and fluid machineries.

Hydraulics is a major topic in the application of science. Fluid mechanics provides the theoretical foundation for hydraulics, which is used as the basis of the calculation of the size of an hydraulic pump and hydraulic cylinder actuator. An actuator is a prime mover used to pressurize the fluid in a hydraulic cylinder to transmit linear motion and power.

Hydraulic cylinder's efficiency is around 95% (as stated by *http.hyraulicspneumatics.com*). The relation of pressure, force, and area of the fluid-cylinder contact is as follows:

F=PxA

A hydraulic pump for the actuator is a fluid machinery used to move fluid in and out of the cylinder. Likewise, the cylinder's, the efficiency of pumps is about 95%.

For a linkage system of lifting purpose, it is very common to use a simple scissor mechanism of linkage, which has an X pattern. As stated by *AICHI, TOYOTA* "Since Charles Larson of the United States was granted a patent for the first scissor lift in 1963, scissor lifts have grown to become the "Swiss Army Knife" of the mobile elevating work platform (MEWP) field."

The platform is one being lifted by the linkages, which is powered by the actuator. In actual, the platform is the pathway for the passengers. The analysis for the size of the platform is a common formula used by textbooks such as *Strength of Materials by Singer, Mechanics of Materials by Gere and Timoshenko, etc*., which is the uniform load formula.

$$M = \frac{wL^2}{8} \qquad \Theta = \frac{wL^3}{24EI} \qquad \delta = \frac{5wL^4}{384EI}$$

Installation of electronic devices can lessen the human error of the operator's. Some electronic devices is to be involved in the design such as water sensors and control processor.

One of the main reason for developing an automated hydraulic pathway is to provide avoidance of disease that can be caught by floodwater contact on the human skin. As per the record of the Department of Health in the Philippines, there were 521 cases reported about leptospirosis from floodwater, and 38 died on 2011. Such data can prove that the development and implementation of an automated hydraulic pathway is recommendable for places in the Philippines which flood frequently happens.

SYNTHESIS

Another type of lifting mechanism that can be used is the slide out carriage mechanism. Base on the observation of the production and operation of slide out mechanism by *P.Claint*, such mechanism is hard to fabricate. In his documentation on *http.photobucket.com*, it is obvious that there were many design considerations. It is required to be drawn in scale first before the parts are to be casted or manually assembled. Unlike a scissor lift, the only major parts are the actuator, hydraulic pump, steel linkages, and platforms.

Catalog designing can be used on choosing hydraulic pumps, while on the size of linkages; it can be analyzed by the use of the principles in statics. These two types of lifting mechanism serves the same function but their fabrication and design is different.

III. METHODOLOGY

At first, the study was conducted by gathering reference in books, internet and advices from the people who has knowledge about hydraulics. The design for this study is an automatic pathway that elevates when a certain height of flood is obtained. Proper system was focused for the design. It was made for pedestrians walking at University Belt because it is always flooded. It is designed to fit two person walking alongside together. The methodology has a brief information about different methods to use in a study. Experimental Research was used for this study, using scientific approach to research by using the principles of fluid mechanics, fluid machineries and strength of materials. After the assembly of the prototype, a test for time efficiency of lifting and descending of the platform was conducted.

IV. RESULTS AND DISCUSSION

In this section, the researcher showed the results they have gathered and the discussion of their prototype, including trials and results they obtain.

The water level sensor that they used is the traditional floater valve (ball) because of its reliability and easy to replace and maintain. The floater switch is connected to two limit switches, one is for switching it up and other is for going down. They used the principle of scissor lift as the basis and thick MS plate for our platform. They connect the scissors section

by means of shafting. They used a solid shaft with a diameter of 1 inch. There are also two springs that served as a cushion to lessen the impact when the pathway goes down. Each connection is welded properly. They used the motor pump from an elf wing van truck and hydraulic cylinder that will act a medium to give force and be able to lift the pathway, it has a 2-ton capacity and 5.5 inches when it operates. They used two batteries for the motor pump to operate.

TABLES AND FIGURES

a.) What water levels will the prototype start to elevate.

TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4	TRIAL 5
16.8 inches	16.8 inches	16.9 inches	17 inches	16.8 inches

The results of the tests are almost the same because the load does not have connection in water level and the load will not affect the floater.

b.) What water levels will the prototype start to go down?

TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4	TRIAL 5
12 inches	12 inches	11.8 inches	12 inches	11.9 inches

It goes in these tests because the load does not have connection in water level and the load will not affect the floater.

c.) How many seconds the prototype reaches the maximum elevation.

TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4	TRIAL 5
(WITHOUT LOAD)	(WITH LOAD, 63KG)	(WITH LOAD, 68KG)	(WITH LOAD, 72KG)	(WITH LOAD, 87KG)
4.62 seconds	5.40 seconds	5.61 seconds	5.82 seconds	6.99 seconds

The lighter the load is, the faster it goes up.

d.) How many seconds will the prototype go down.

TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4	TRIAL 5
(WITHOUT LOAD)	(WITH LOAD, 63KG)	(WITH LOAD, 68KG)	(WITH LOAD, 72KG)	(WITH LOAD, 87KG)
5.57 seconds	4.66 seconds	4.5 seconds	4.4 seconds	4 seconds

e.) The maximum capacity of the system.

The maximum capacity of the system is 200kg or two persons because of the pressure valve that limits the motor pump to discharge more fluid.

EQUATIONS

- Pressure, force and contact area relationship

$$F = PA$$

- Uniform Load Beam Formula

$$M = \frac{wb^2}{8}$$

$$\Theta_r = \frac{wl^3}{24EJ}$$

$$\Delta = \frac{5wL^4}{384EJ}$$

- Shear Stress Equation

$$Ss = \frac{16T}{\pi Di^3}$$

- Tensile Stress Equation

$$St = \frac{F}{A}$$

- Compression Stress (at the threads)

$$Sc = \frac{F}{\frac{\pi}{4}(Do^2 - Di^2)\,Nt}$$

- Bearing Maximum Stress

$$S_{bmax} = 0.31Smax$$

V. CONCLUSION

This study focus on providing an automatic pathway that will elevate when it senses floodwater at its required level. The researchers focus on what type of proper system in applying hydraulics will be used and the proper materials to use in the input and output of the system why considering its prices and availability. The size of the pathway is enough for the people using the emergency automated hydraulic pathway to be safe. The load that the system can withstand is limited for 1 to 2 persons in one area at the same time.

VI. RECOMMENDATIONS

This study limits only on the connection of the hydraulic system, system elevation of the pathway and automation by using water level sensor. Therefore, the first recommendation is the sealing of the oil tank, hydraulic hose and hydraulic cylinder to avoid the leaking and engagement of the hydraulic oil into the floodwater. The second recommendation is to install an alarm that will alert the people when the system is elevating or depreciating. Moreover, the third recommendation is to install stairs with wheel in its feet in both ends of the platform.

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BIOGRAPHY

Jessa Pacayra Ornopia was born on January 4, 1993. She studied at Christian Grace School of Cavite since Kinder to High school. She studied Bachelor of Science of Mechanical Engineering at Lyceum of the Philippines University Cavite.

She attended several seminars during her time in college, such as Hydraulic Bench Training, Osbourne Reynolds Apparatus Training, Digital Saybolt Viscometer Training, Tilting Flow Channel, Safety Practices in Engineering and so much more.

Their thesis was Emergency Automatic Hydraulic Pathway by Ornopia. She is a member of Philippines Society of Mechanical Engineer She won at a Championship in AutoCAD Rendering and Detailing Contest and AutoCAD Design Completion.

John Paul Batalla Lomibao was born on August 11, 1992. He studied at Immaculate Conception Academy Cavite (High school) and Lyceum of the Philippines University - Cavite Campus. He graduated with a degree in Bachelor of Science in mechanical engineering at Lyceum of the Philippines University - Cavite Campus in 2014.

He attended multiple of seminars such as 2nd PSME National Student Conference: ME Students: Moving Forward Towards Global Competitiveness on October 23-26, 2012 at SMX Moa Convention Center, Pasay City, Manila, Hydraulic Bench Training on May 7-10, 2012 at Lyceum of the Philippines University- Cavite Campus, Osbourne Reynolds Appartus Training on May 7-10, 2012 at Lyceum of the Philippines University- Cavite Campus, and Digital Saybolt Viscometer Training on May 7-10, 2012 at Lyceum of the Philippines University- Cavite Campus.

Their thesis was Emergency Automated Hydraulic Pathway. He is a member of Philippine Society of Mechanical Engineers National Chapter and he won the First Place at AutoCad Rendering and Detailing Contest.