



The New Lifting Bridge

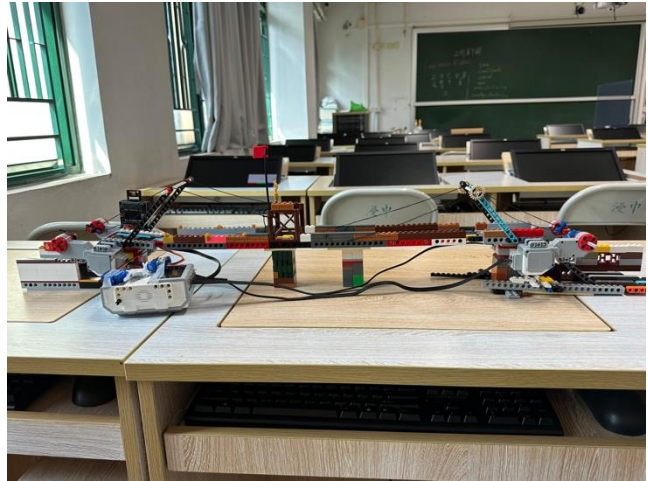
Authors : Hong Ka Hou

Hyodo Michael Mo Yat

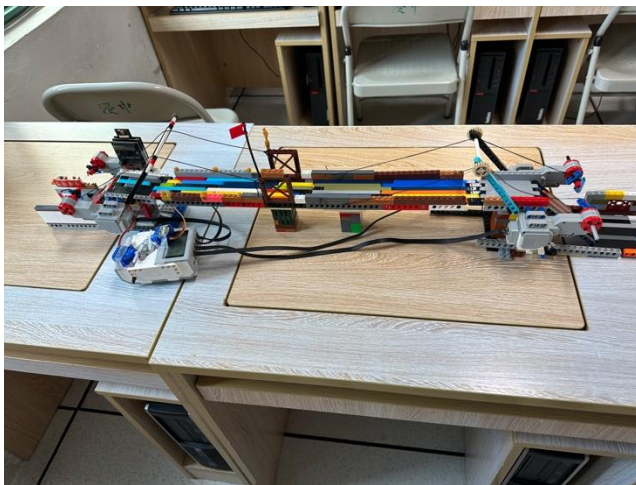
Wong Chi Chio

Overview:

Along with the Macau's urban planning development, the construction of the fourth bridge across the sea have already been started in 2020 and is expected to



be completed in early 2024. In view of the impact of the bridge construction and the need for marine traffic development, we propose a New Lifting Bridge.



In addition, to create a smart city, the New Lifting Bridge can play a major role in identifying vessels as they pass by, raising the bridge and

allowing them to navigate quickly. The New Lifting Bridge also significantly reduces the need for manual control of the bridge and reduces the frequency of accidents.

Contents:

I. DESIGN CONCEPT	4
II. PURPOSE OF THE STUDY.....	4
V. RESEARCH RATIONALE.....	6
VI. RESEARCH PROCESS	6
VII. CONCLUSIONS OF THE STUDY	7
VIII. SUMMARY	7
IX. STRENGTHS	8
X. PRACTICAL PROSPECTS	9
XI. PROCEDURE CODE.....	11
XII. MOVIE	12
XIII. SOURCE INFORMATION.....	13

I. Design concept:

At present, the average number of sea freight trips to and from the port of Macau is about 400 per month, and with other vessels sailing in and out of Macau waters, sea transport is important and cannot be ignored.

Vessel traffic on the sea is inevitably subject to accidents, especially when passing underneath the bridge, where the height of the vessel or tools may hit the height limit. Therefore, we propose to develop a new type of lifting bridge, in order to add an intelligent inductive lift function with object recognition for vessels sailing on the sea, highlighting the flexibility of the bridge and the efficiency of vessel passage.

II. Purpose of the study:

The invention is to create a lifting bridge with object recognition that can be used in infrastructure construction projects. When a vessel approaches the bridge, the bridge can send a signal to the backend of the system via camera image recognition to temporarily stop traffic on the bridge and raise the bridge so that the vessel can leave quickly, and increase the vessel traffic

flow. When the vessel leaves the bridge, the bridge immediately lowered to allow the vehicles to continue driving.

III. Research Log:

Discussion of possible research topics in November 2022

Report writing, materials planning in December 2022

Making models and writing programming in January and February 2023

Repeated testing and adjustment of parameters in March and April 2023

Work completed in May 2023

IV. Raw Materials For Production:

1. LEGO blocks
2. LEGO MINDSTORMS EV3 motor
3. COCOROBO Lens Module
4. COCOROBO servo motors

5. Rope

V. Research Rationale:

1. Mechanical principle - the basic elements of force, mechanical tools and work are used, together with motors and gears to control lifting and lowering.

2. Object recognition principle - when the object detection algorithm detects an object, a rectangular bounding box is used to mark the location of the detected object in the image.

VI. Research process:

In some parts of the world, the design of lifting bridges is used to facilitate the movement of ships at sea, focusing on the appearance of the bridge and the way it opens and closes. Our focus is on object recognition and intelligent sensing to automatically raise and lower the bridge when a vessel passes by.

In the process, we wrote the LEGO MINDSTORMS EV3 program as a lifting element and the COCOROBO object recognition program to determine the distance between the ship and the bridge and the size of the ship.

VII. Conclusions of the study:

In order to increase the efficiency of bridge and boat traffic, we designed this new lifting bridge with object recognition, auto-sensing and intelligence. Although many countries or regions in the world have similar lift bridges that greatly improve the efficiency of nearby residents and traffic, we improved on the basis of being able to make the bridge lift and open and close. Through our continuous investigation and under the guidance of our teachers, we have finally succeeded in inventing this ideal piece of work.

VIII. Summary:

Technology is advancing day by day and we need to keep up with the times. Technology is not only used in everyday life, but also in cities, making

them intelligent. Smart cities are relevant to us, and the new lifting bridges can be used in large infrastructure projects to promote urban development. We have invented the lifting bridge to make it more flexible and easier to integrate into the city. At the same time, it also facilitates easier and more efficient maritime transport. Through our own technological innovations, we have been able to realise the benefits and importance of technology by making it multi-functional and intelligent. We hope that our modest efforts can quietly contribute to the development of Macau's smart industry and infrastructure.

IX. Strengths:

Analysed and compared with the relevant literature retrieved, the conclusions are as follows:

Research 1: The main focus is on the design of a large highway lift bridge of beautiful form and character, in harmony with the environment and efficiency of use, for the river lift bridge in Seine-et-Marne, Rouen, France.

Research 2: focuses on the opening method of the opening bridge in Terengganu, Malaysia, and the innovative technology.

In summary, research has been reported in many countries on the design of lift bridges and the way they open. However, the research on this topic is characterised by

1. Object recognition
2. Auto-sensing
3. Intelligent

X. Practical Prospects:

1. Object recognition

Our new lifting bridge is object recognition, which means that a number of intelligent lenses are installed at the front, middle and rear of the bridge to identify the vessel and thus determine the safe distance between the vessel and the bridge to achieve the appropriate lift time as well as feedback to the land-based traffic signals.

2. Auto-sensing

When the vessel comes to a suitable safe distance from the bridge, the ends of the bridge will light up in red, land traffic will be temporarily stopped and the bridge will then be raised to allow the vessel to pass; when the vessel has completely left the bridge, the bridge will then be lowered, the ends of the bridge will light up in green and land traffic will resume as normal.

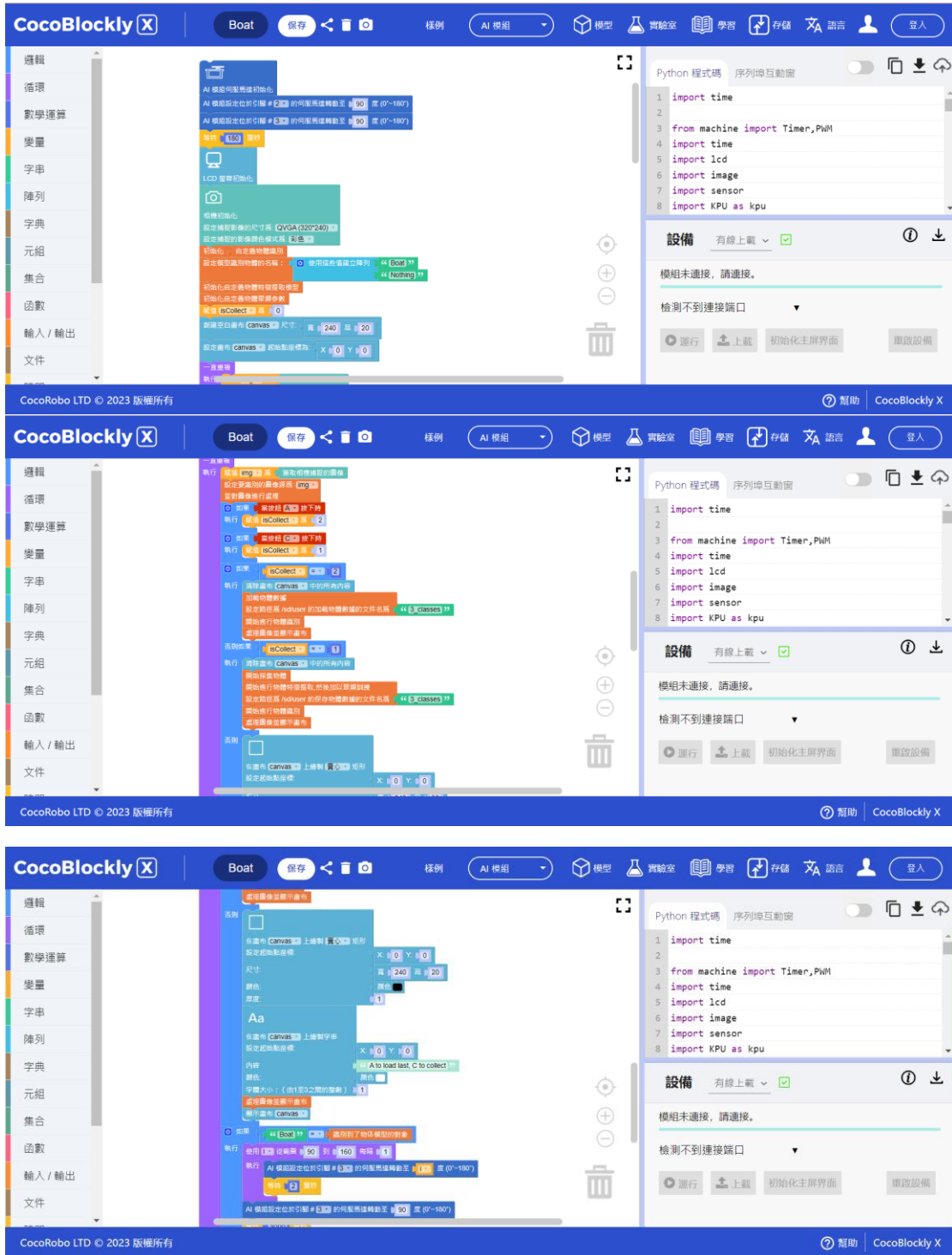
3. Intelligent

The raising and lowering of the entire bridge is entirely programmed to reduce manual handling, labour costs and time costs.

In order to solve the efficiency of the bridge and sea traffic, a lifting bridge with object recognition, auto-sensing and intelligence is undoubtedly one of the solutions, the main use of which is not only to increase traffic efficiency, but also to bring tourism benefits to Macau, a lifting bridge across the sea will certainly add endless colour and tourism benefits to the tourist city of Macau, attracting countless tourists.

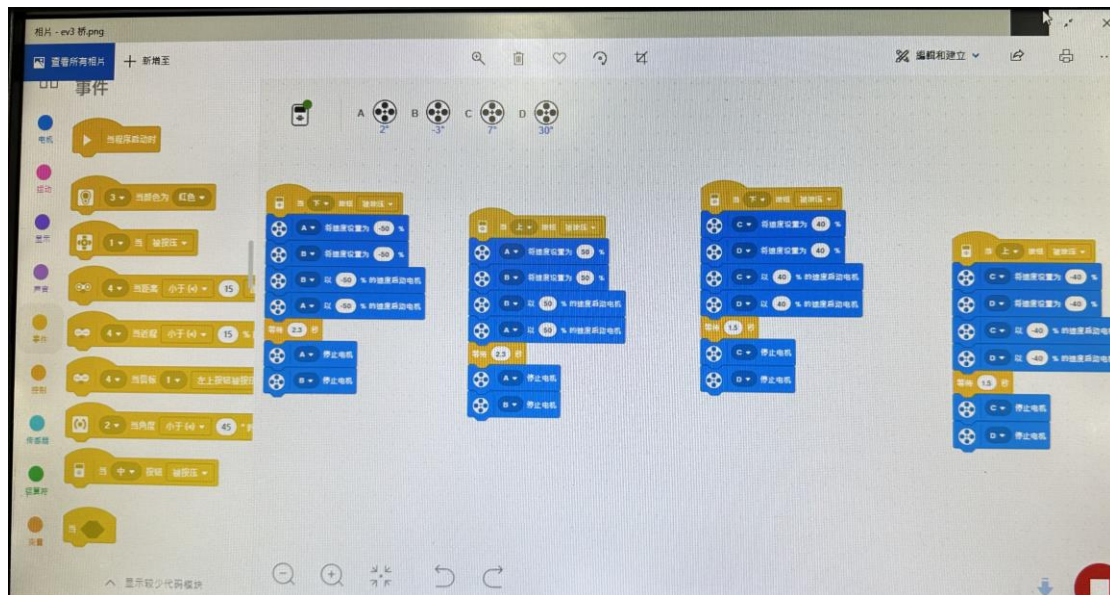
XI. Procedure Code:

COCOROBO object recognition procedure:





LEGO MINDSTORMS EV3 Program:



XII. Movie:

<https://www.bilibili.com/video/BV1ro4y1b7kf/>

XIII. Source Information:

1. Wang, Y. N., & Hu, H. B. (2009). (2009). Lift-open bridge over the Seine-et-Marne, Rouen, France. *Bridges of the World*, (1), 1-3.
2. Kong X, Zhou Gang, Sheng Zhaohui et al. (2022). Bridge opening in Terengganu, Malaysia. *Lifting and Transport Machinery*, 2, 51-55.