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Enhancing Urban Road Traffic Regulation Using Grafcet - based Command Control System for BINTI Rolling Robot in Lubumbashi

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Abstract: ***Automation has led to the use of robots in urban settings to enable the regulation and control of road traffic. The BINTI rolling robot used in the city of Lubumbashi is a specific case of the use of robots in urban areas. However, this BINTI rolling robot poses some problems in its operation leading to poor regulation of road traffic caused by a weakness in its operation, preventing for example from taking into account the flow of vehicles in order to give priority to certain arteries with more traffic. Vehicles compared to others. This study aims to set up a command control system by developing a grafcet to improve the operation of said robot.***

Keywords: Automation, robots, urban settings, road traffic regulation, BINTI rolling robot, city of Lubumbashi, operation problems, flow of vehicles, priority, command control system, grafcet.

1. Introduction

Automation has led to the use of robots in urban settings to enable the regulation and control of road traffic. As a result, road traffic police (PCR) officers find themselves either assisted or replaced by robots that control and ensure the regulation of road traffic. In the Democratic Republic of Congo (DRC), an innovation has been made in the field of engineering through the design of a robot called BINTI which regulates road traffic. These rolling robots have been deployed in several provinces of the country, particularly in upper Katanga and more particularly in the city of Lubumbashi, in place of the post office, as well as at the intersection of avenues du 30 juin and avenue kilelabalanda.

However, despite this innovation in the context of modernization, we have noted certain flaws in the operation of this BINTI rolling robot which has repercussions on road traffic regulations.

As we know, every human work is always characterized by imperfections. Indeed, the BINTI rolling robot poses some problems in its operation leading to poor regulation of road traffic causing traffic jams. We found that this rolling robot lacks a certain intelligence to take into account the flow of vehicles in order to give priority to certain arteries having more vehicles compared to others. In addition, the waiting period before rotation does not respect a certain logic in order to ensure good road traffic regulations. It is this state of affairs that led us to conduct a study to try to improve the operation of the BINTI rolling robot and remedy the aforementioned problems.

Therefore, we found it important and necessary to conduct a study that will improve the operation of the BINTI rolling robot and ensure better regulation of road traffic in Lubumbashi. Thus, our research is entitled: “Study of the implementation of an automated system for improving the operation of the BINTI rolling robot”.

To answer the question of understanding the situation presented above, we will first begin by laying the theoretical foundations of our research object. Then, we will determine the methodological tools that will allow us to embark on the research field in order to gather the tools necessary for the development of the control system of the BINTI robot.

Our research question that will be the subject of our study is: “By what mechanism can we manage to make the BINTI taxiing robot intelligent in Lubumbashi for better regulation of road traffic? ". Through this question, we believe that our objective of improving road traffic regulation will be achieved. Our study aims to make the BINTI driving robot more intelligent following its current operation, which is fixed on a simple timing system that does not allow road traffic to be effectively regulated in the city of Lubumbashi. To achieve this, we will study the current behavior of the robot's control system and then proceed with the development of a GRAFCET of the new system which will be equipped with an API (Programmable Logic Controller) to which field instruments will be connected (sensors, actuators, etc.) necessary to control the BINTI rolling robot in order to ensure proper operation.

Each research having its own realities, each research can condition the choice of the other data collection technique. It is in this sense that Ruquoy (1995: 60) emphasizes that the data collection method should be adapted to the type of data sought. To collect the data we will use observation, semi - structured interviews, conversational interviews and the documentary technique.

2. Development of the operating control system for the BINTI rolling robot

2.1 Presentation of the BINTI robot made in DRC

Also located in the province of Haut Katanga in the Democratic Republic of Congo, the BINTI rolling robot is a totally Congolese invention, developed by Congolese inventors with the financial support of LWOMEN technologies, an association of women engineers from the DRC. Equipped and powered by a solar panel, it manages to organize traffic. This said robot works on a principle of time delay such that the rotations of movement in different directions are carried out after 30 seconds. This has a drawback, in particular that of not taking into account the number of vehicles on the various traffic axes and thus creating a traffic jam.

2.2 Automation and automated production system

"Automation is about making operations that previously required human intervention automatic. " The objectives of automation are therefore: Eliminate repetitive tasks, Simplify human work, Increase safety (responsibility), Increase productivity. A production system is said to be automated when it can autonomously manage a pre - established work cycle which is broken down into sequences and/or stages. They consist of several more or less complex parts linked together: the operational part (PO), the control part (PC) or control/command system (SCC); the relationship part (PR) increasingly integrated into the control part.

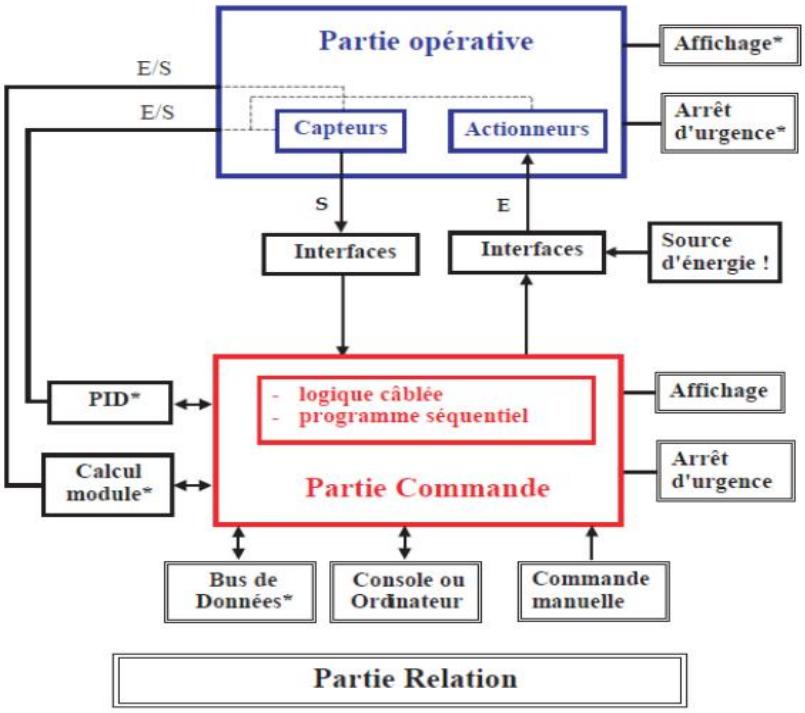

Figure 1: Level 1 Grafcet of the new BINTI rolling robot control system

2.3 BINTI rolling automation specifications

The specifications are the description provided by the user to the designer of the automation to indicate to him the different operating modes and the safeties that the automation must have. The specifications describe the behavior of the operational part in relation to the control part. The automation engineer must refer to the specifications to carry out the automation, it is binding. GRAFCET, flowcharts, flowcharts, chronograms are tools used to describe the behavior of an automated system.

When the robot is powered up, the initialization conditions have been set so that the rolling robot indicates an orange light in all directions. After 5 seconds, it indicates a red light in all directions. After 5 seconds, we choose a situation such that the rolling robot lights a green light on channel A, and a red light on channel B. The position sensor indicates the current position of the cylinder. After 5 seconds, the count is made on the vehicles in the waiting areas. Knowing that each lane has two axes, the numbers of the vehicles of the two axes of each lane will be added and then compared with the result of the perpendicular lane. The API receives these results on the basis of which it controls the robot. The counters must be reset each time the rolling robot rotates.

2.4 Synoptic diagrams of the proposed new control system

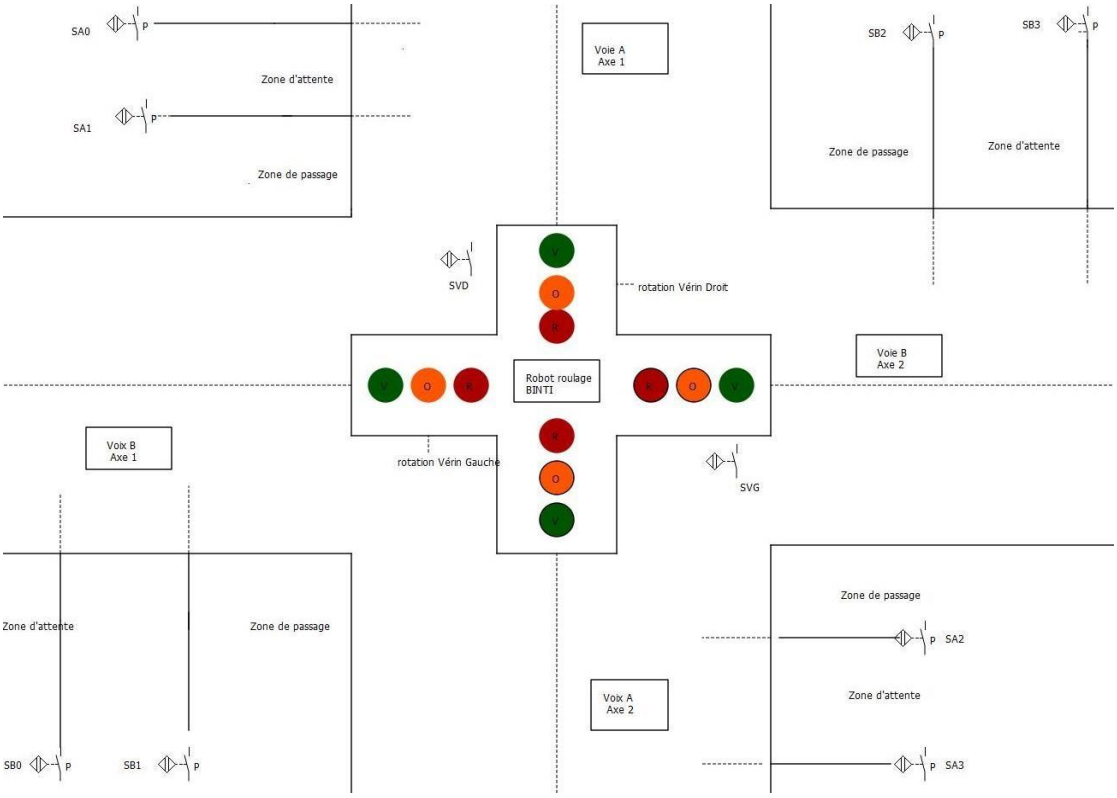

Figure 2: Block diagrams of the new model of the BINTI control system

2.5. Mnemonic for robot controller field instruments

- SVG: Cylinder left position sensor
- SVD: Cylinder right position sensor
- C1: Track A axis 1 vehicle counter
- C2: Track A axis 2 vehicle counter
- C3: Track B axis 1 vehicle counter
- C4: Track B axis 2 vehicle counter
- LV: Left cylinder
- RV: right cylinder
- DCY: power button
- LVA: channel A green light
- LOA: orange light channel A
- LRA: channel A red light
- LVB: channel B green light
- LOB: channel B orange light
- LRB: channel B red light
- SmA: total track A vehicles
- SmB: total track B vehicles
- SA0: Vehicle sensor lane A axis 1 waiting area
- SA1: Vehicle sensor track A axis 1 passage area
- SA2: Vehicle sensor lane Aaxe 2 waiting area
- SA3: Vehicle sensor track A axis 2 passage area
- SB0: Vehicle sensor lane B axis 1 waiting area
- SB1: Vehicle sensor track B axis 1 passage area
- SB2: Baxe 2 lane vehicle sensor waiting area
- SB3: Vehicle sensor track B axis 2 passage area

2.6. GRAFCET of the new BINTI rolling robot control system

2.6.1 Level 1 GRAFCET

Level 1 GRAFCET is used to represent the desired operating sequence. The description of the actions and the sequence of the automatism is literal. Level 1 GRAFCET is used to identify the functions that the automation must perform. For each of these functions, it is necessary to deduce what are the actions to be carried out.

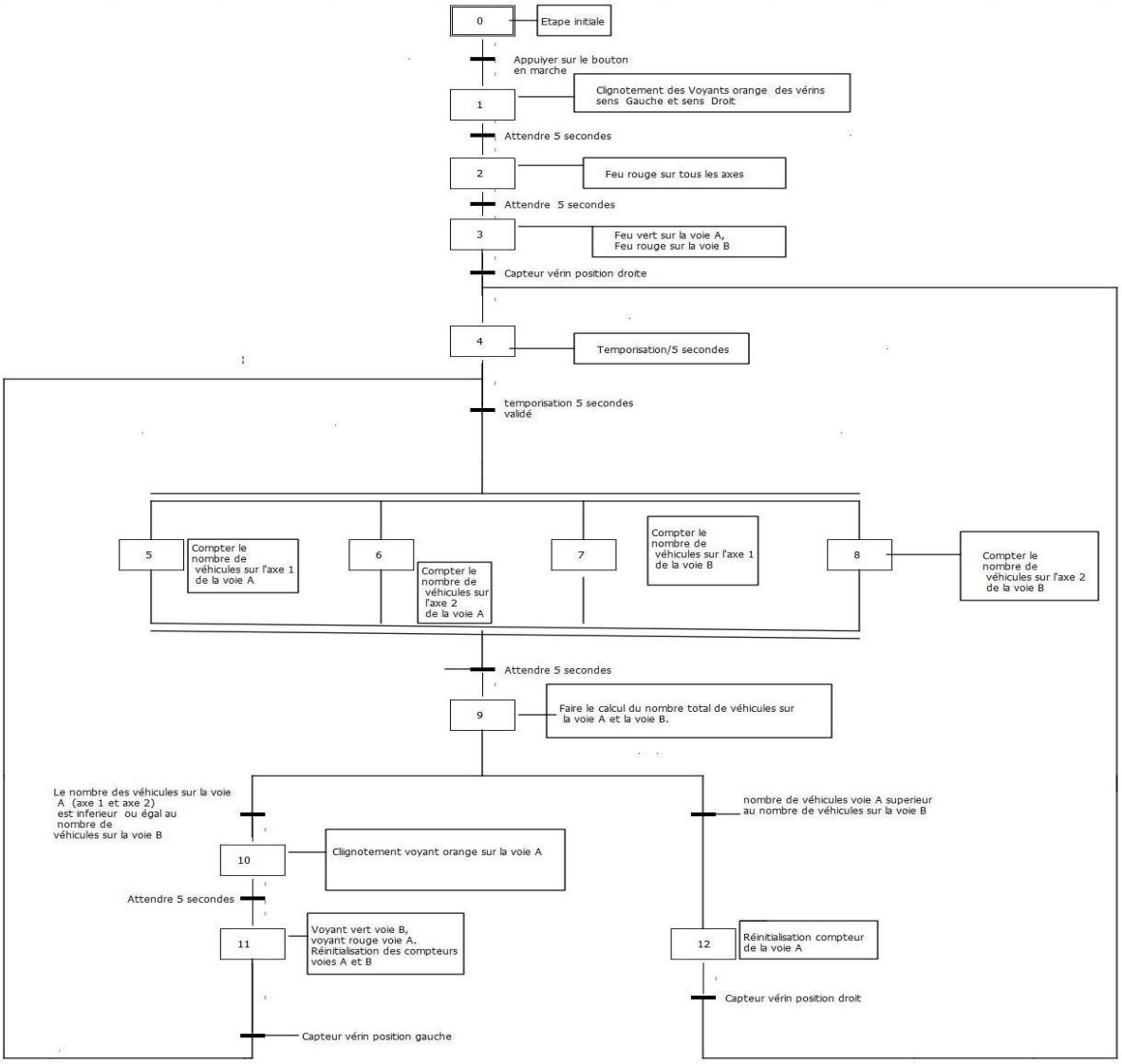

Figure 3: Level 1 Grafcet of the new BINTI rolling robot control system

2.6.2. GRAFCET level 2

Level 2 GRAFCET is the one that takes sensor and actuator technology into account. It could lead to the programming of a PLC or a wired sequencer.

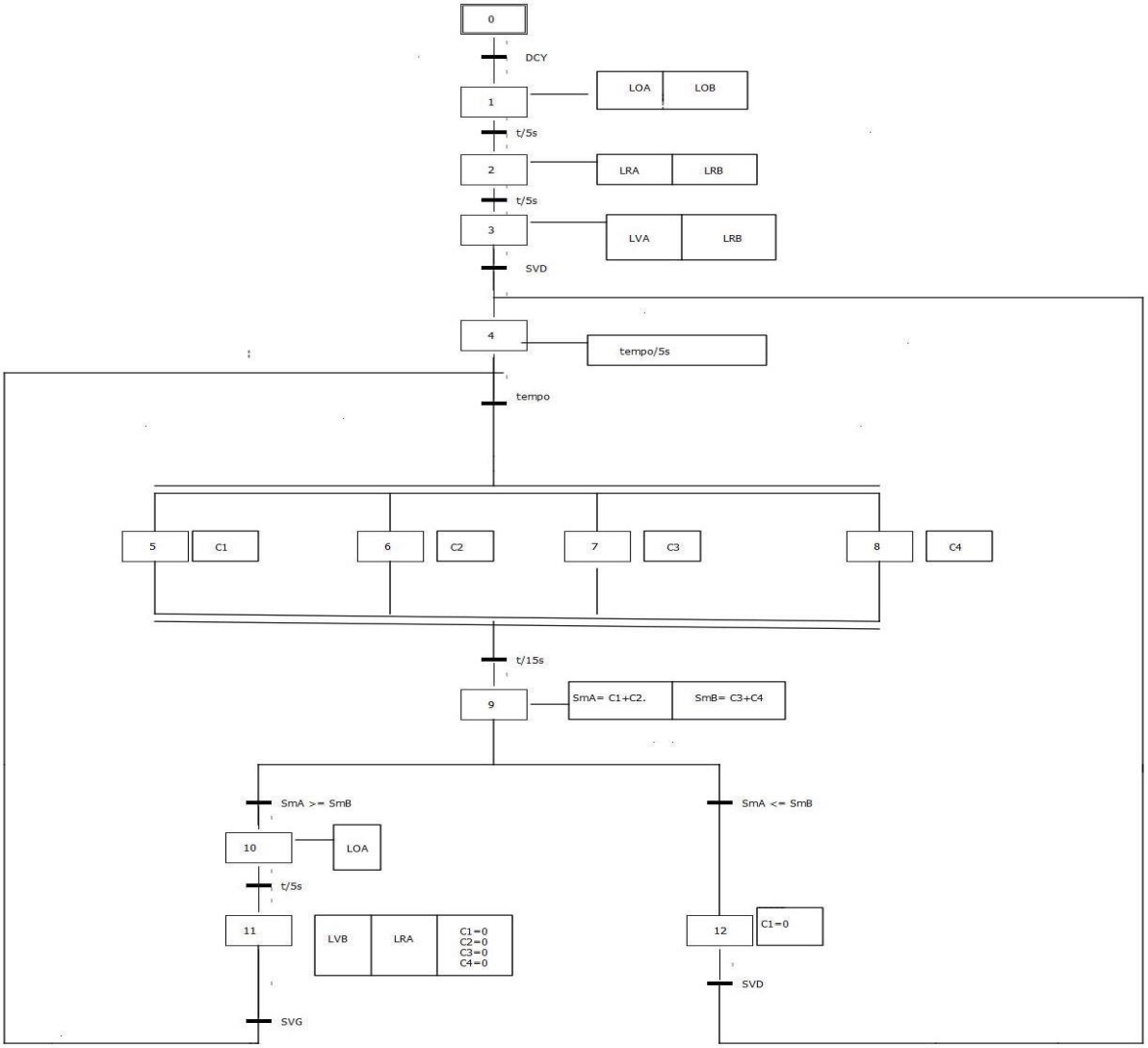

Figure 4: Level 2 Grafcet of the BINTI rolling robot operating system

3. Conclusion

Here we are at the end of this study entitled: Study of the implementation of an automated system for improving the operation of the BINTI rolling robot. Indeed, this study aimed to set up a control and command system for piloting the BINTI robot in order to make it much more intelligent in its reasoning and allow better control of road traffic in the arteries of the city. from Lubumbashi this robot is installed. We started by studying the operation of the robot then establishing a new specification which then allowed us to bring out a grafcet of the new control system. It is for this reason that we believe that this study could improve the operation of the BINTI robot and solve the problems mentioned in the problem.

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