

# Implementation of Barcodes Data Transfer to MELFA Robots

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**Abstract** — The current paper presents the implementation of barcode reader and human machine interface for loading data from printed on paper barcodes to MELFA Robot. The aim of the present development is to increase the efficiency of automated production. After the implementation of the functionality the productivity of the automated system has increased with 28%, because of the shortage of the time for inputting the data via barcodes, barcode reader and human machine interface.

**Index Terms** — robots, automation, barcode, human machine interface.

## I. INTRODUCTION

The current paper presents implementation of barcodes, barcode reader and human machine interface (HMI) for loading data to MELFA robots. The used hardware is as follows:

1. 6-axis robot Mitsubishi Electric RV-2F-Q1-S15 (Figure 1)[1][2], which was presented in the article "Algorithm for taking, orienting and placing an object with a 6-axis robot and a 2D camera for visual inspection"[4]. Where the anthropomorphic manipulator picks up components, it orients them correctly by means of a technical vision camera so that they can be mounted in a certain place in the electronic device in a more appropriate way [3][6].



Fig. 1. Robot Mitsubishi Electric RV-2F-Q1-S15 – 6-axis

2. Human machine interface (HMI) or so called graphic operation terminal (GOT) [7]. The used terminal is GOT

SIMPLE Series GOT 2000 GS2110-WTBD, Figure 2. It has one ethernet interface, two serial communication ports (RS-232 and RS-422), one Mini-B USB interface and SD memory card interface.



Fig. 2. GS2110-WTBD

3. ZEBRA LS1203-HD General Purpose handheld scanner, Figure 3. Designed for electronics manufacturers who need to scan small, high density 1D barcodes on PCB assemblies for track, trace, quality and other applications, the LS1203-HD provides the performance and features needed to boost productivity day in and day out. Easy and comfortable to use, this high-value cost-effective laser scanner offers reliability and investment protection.



Fig. 3. ZEBRA LS1203-HD

4. Barcodes with special data inside about the operator of the machine, the type of parts to be produced, the characteristic of the parts and quantity, Figure 4.

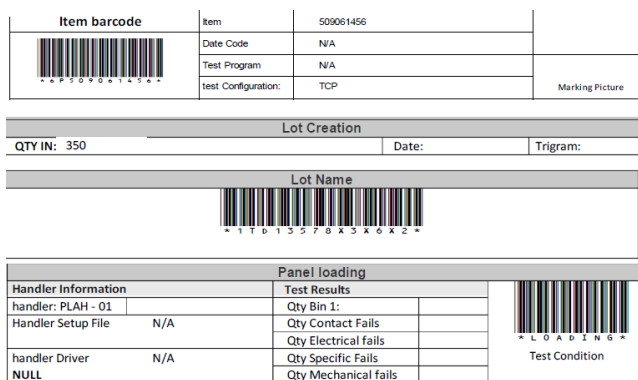


Fig. 4. Barcodes

### II. MELSOFT GT WORKS3 SCREEN DESIGN SOFTWARE

The GOT screen design software which is used to program GOT terminal is MELSOFT GT Works3 [5]. This integrated software is used to create professional screen designs for GOTs. It was developed, keeping in mind simplicity, sleekness and user-friendliness. This is a powerful tool that pushes boundaries and delivers endless design possibilities. The GT Works3 software has many features and benefits. The main are:

- Software for creating HMI screens;
- Easy screen design by using “Labels” instead of devices;
- Easy maintenance abroad with “Multi-language Support”;
- Faster device input with “Input Assist”;
- Templates” simplify screen customization;
- Data Verification” is ever more convenient!;
- Easy navigation;
- Work tree;
- Toolbar;
- Screen elements library;
- Dialog boxes;
- Simulator function (Real and simulator);

The software can be connected to PLC and Robot directly, without GOT terminal. On Figure 5 is presented sample screen for GOT2000.



Fig. 5. Sample screen of GOT2000

### III. MAIN TASK AND STEPS

The main purpose of implementing the barcodes as data carriers is reducing the startup time and increasing the production time.

Main tasks and steps to implement the upgrade to the system are:

1. The first step is to scan barcode with barcode laser scanner.
2. The second step is to read the data with GOT terminal, to separate the data from the different barcodes, to find the right recipe to be send to the robot and to upload the recipe to MELFA robot.
3. Step three is to start production. It is not part of this topic. It was disused in Algorithm for taking, orienting and placing an object with a 6-axis robot and a 2D camera for visual inspection "[4].

Steps from 1 to 2 must be performed only once for cycle.

Block diagram of the process is shown on, block scheme in Figure 6.

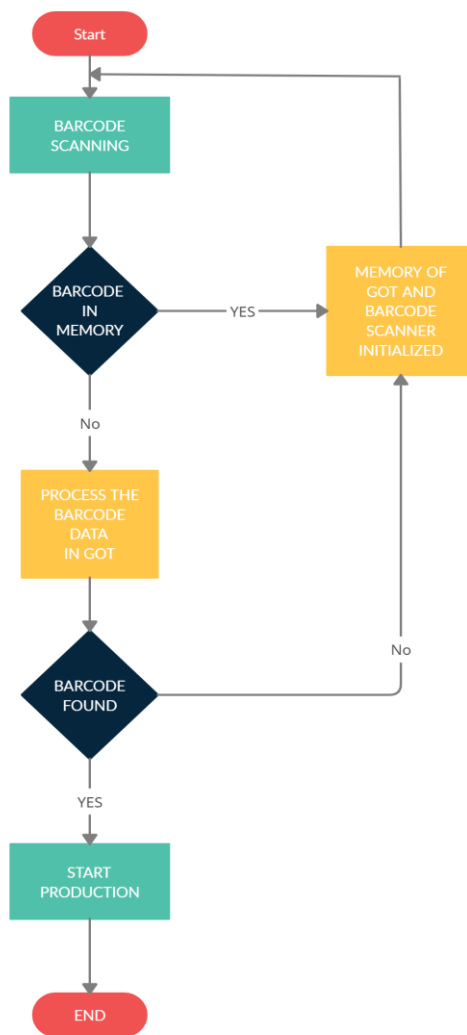


Figure 6. Block Diagram of the process.

#### IV. METHODOLOGY FOR READING, PROCESSING AND TRANSMISSION OF DATA

Operator must take the barcode scanner, scan all barcodes which are printed on his worksheet, should compare the data written on his and visualized on the terminal and if the data match to load it to the robot.

The first step in the methodology is to make the proper settings inside the terminal for communicating and reading data from barcode reader. In Fig. 7. Are shown the setting which are made. After this settings the communication is established.

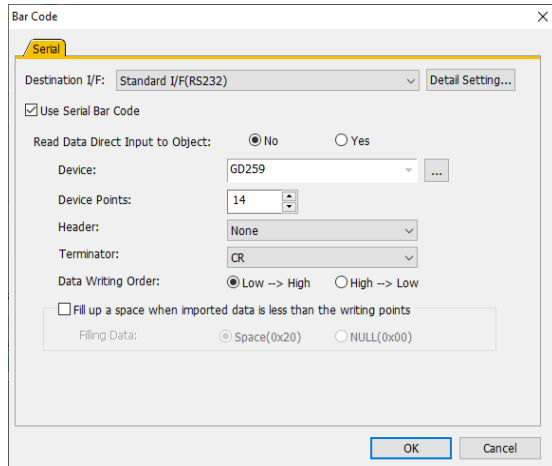


Fig. 7. Setting the GOT terminal communication with ZEBRA barcode reader

The barcode reader is connected via standard I/F (RS-232). The communication is established easy because of the implement algorithms inside the barcode reader.

The second step is to reinitialize and transfer the raw read data, from the barcodes, to the specified fields and in readable format. This is step is accomplished by three Scripts. The script is a file of programable codes based on C#.

```
bmov([w:GD260],[w:GD360],14); (1)
```

The first script is about translation of the data from the barcode memory to the GOT memory, equation (1).

```
bmov([w:GD360],[w:GD370],1);
if([w:GD370] == S10){
    bmov([w:GD360],[w:GD380],14); //10S - handler
    Only 10 in Scrip Symbol, because of 1 = 2 letters
}
else{
    if([w:GD370] == T1){
        bmov([w:GD360],[w:GD400],14); //1T - lot
    }
    else{ (2)
        if([w:GD370] == C1){
            bmov([w:GD360],[w:GD420],14); //1C -
            condition
        }
        else{
            if([w:GD370] == P6){
                bmov([w:GD360],[w:GD440],11); //6P - item
                bmov([w:GD441],[w:GD300],9);
            }
        }
    }
}
```

The raw data is moved bit by bit from the barcode memory to the GOT memory. If more than one bit is moved at a time, a possible missing data will occur.

The second script is about converting the data from raw format to readable information and distributing it to the correct fields, equation (2). The barcodes have two or three symbols which are invisible in the text at the bottom of the barcodes, but after scanning them they are visible in the barcode reader memory. This symbols are cods for the type and formatting of the barcode. This information is useless for us, but can be used as separators.

If the operator tries to scan second time the same barcode the barcode distributing is reset and the procedure must be performed one more time. The script responsible for this is equivalent to formula 2, but with the difference that the addresses are filled with NULL. This is performed of safety reasons.

If third step is to compare and load the data to the robot. The third step is described in chapter V.

#### V. TRANSFER DATA FROM GOT TO MELFA ROBOT

Before transferring the data to the robot the information about all combinations and types of parts is fulfilled in specific data register called Recipe. The recipes keep all kind of data in the ROM memory of the terminal and cannot be lost du to power off. Because of that reason the recipes are used for data which is not supposed to be changed very often. This data can be integers, floats, characters and strings. On Figure 8 is shown the recipe used for this article. The data is stored in 26 devices every device has 200 predefined records. There is an option for adding new data via special designed menu on the GOT.

No.	Device	Device Type	Points	Character Count (one byte)	Display Type	Read Expression	Decimal Point	Device Comment	Record 1	Record 2	Record 3
1	GD1800	String	6	12			0				
2	GD1801										
3	GD1802										
4	GD1803										
5	GD1804										
6	GD1805										
7	GD1814	Signed B0102	1	-	Real	Fixed Decimal	0	Spool PCB # 10	10	10	10
8	GD1816	String	3	6	String		0	Head no unit	A	A	A
9	GD1817										
10	GD1818										
11	GD1806	String	2	4	String		0	Bag volume	T039	T039	T039
12	GD1807										
13	GD1808	Signed B0102	1	-	Real	Fixed Decimal	2	Runes amount	6.29	6.29	6.29
14	GD1810	Signed B0102	1	-	Real	Fixed Decimal	2	Bechmes no	13.00	13.00	13.00
15	GD1812	Signed B0102	1	-	Real	Fixed Decimal	0	Spool volume	55	55	55
16	GD1820	String	5	10	String		0	Head no unit	S0001482	S10001429	S10001424
17	GD1821										
18	GD1822										
19	GD1823										
20	GD1824										
21	GD1842	String	3	6	String		0	Bag PCB10-L...	Blue	Blue	Blue
22	GD1843										
23	GD1844										
24	GD1840	Signed B0102	1	-	Real	Fixed Decimal	2	Bechmes no	4.19	4.19	4.19
25	GD1846	Real			Real	Fixed Decimal	0	Spool count	16	16	16
26	GD1848	Signed B0102	1	-	Real	Fixed Decimal	0	Head no unit	1	1	1

Fig. 8. Recipe

The connection between the barcodes and the recipe, etc. the search inside the recipe according to the barcodes is done automatically in formula 2 line 18. The data register who is assigned for the searching is mapped with the recipe search address, GD300.

If the operator is on another screen the barcode distribution doesn't work, this is implemented because of safety reasons.

When a correct barcode is scanned, "PRODUCT NUMBER" is automatically filtered. Select "PRODUCT NUMBER". Now the operator must compare is the information filled in the field on the left is correct, Figure 8. If the information is the correct one the operator must press the "LOAD RECORD" button. While the recipe is loading the button "ZAR. RECORD" flashes green. When the recipe is loaded, the button stops flashing and turns green.

Now the information is loaded to the robot and manufacturing can be run.

On Figure 9 is shown the screen for barcode read, transform and send.



Fig. 9. Barcode and recipe screen

### VI. CONCLUSION

Studies have shown that after the implementation of the barcode scanner and barcodes to the automated system the processing time for starting up the system has decreased with 33%.

After implementation the upgrades into the real automated system the time for start new cycle has decreased with 28%. The difference between the studied value and the real value comes from the human factor.

The new implementation met the expectations and the main goal. The automated system is working for 24 hours per day and has increased the productivity with 63.887%.

### REFERENCES

- [1] J.-M. Niu, "Design and Control of Automatic Tool Changer for Machine Center," 2016 International Conference on Mechanics Design, Manufacturing and Automation (MDM 2016), ISBN: 978-1-60595-354-0
- [2] Mitsubishi Electric Europe B.V. FA, Available: [https://www.allied-automation.com/wp-content/uploads/2015/02/MITSUBISHI\\_RH-6FH-D12FH-D20FH-D-Series-Instruction-Manual-Robot-Arm-Setup-Maintenance.pdf](https://www.allied-automation.com/wp-content/uploads/2015/02/MITSUBISHI_RH-6FH-D12FH-D20FH-D-Series-Instruction-Manual-Robot-Arm-Setup-Maintenance.pdf)
- [3] In-Sight 2000 Vision Sensor, <https://www.cognex.com/en-bg/products/machine-vision/vision-sensors/in-sight-2000-vision-sensors>
- [4] Kostov B., Hristov V., "Algorithm For Picking, Orienting And Placing An Object With A 6-Axis Robot And A 2d Visual Inspection Camera", *Proceedings of the Technical University – Sofia*, Volume 70, Issue 1, pp. 40–49, ISSN 1311-0829, DOI: 10.47978/TUS.2020.70.01.005, (2020).
- [5] Mitsubishi Electric Europe B.V. FA Available: <https://dl.mitsubishielectric.com/dl/fa/document/manual/got/sh081220eng/sh081220engaj.pdf>
- [6] Slavov, D., "Object Size Estimation with Industrial Robot Gripper Using Neural Network and Machine Learning", *International Conference Automatics and Informatics (ICAI)*, Varna, Bulgaria, pp. 1-4, DOI 10.1109/ICAI50593.2020.9311319, ISBN: 978-172819308-3, (2020).
- [7] Mitsubishi Electric Europe B.V. FA, Available: <https://dl.mitsubishielectric.com/dl/fa/document/catalog/got/108762eng/108762enga.pdf>
- [8] ZEBRA Technologies Corporation USA, Available: [https://www.zebra.com/content/dam/zebra\\_new\\_ia/en-us/manuals/global-manuals/advanced-data-formatting-advanced-programmer-guide-a-en-us.pdf](https://www.zebra.com/content/dam/zebra_new_ia/en-us/manuals/global-manuals/advanced-data-formatting-advanced-programmer-guide-a-en-us.pdf)