Digital Process Sequencing for Industrial Assembly Lines & Automated Task Update System

Prashant Hiratkar[1] Shubham Deshmukh[2] Parag Petkar[3] Prajakta Patil[4] Samruddhi Ghode[5]
[1,2,3,4,5]B.E. Student
[1,2,3,4,5]Department of Computer Technology
[1,2,3,4,5]Rajiv Gandhi College of Engineering & Research, Nagpur, India

Abstract— The assembly line of any JCB product requires careful follow-up of a SOP (Sequence of Processing), which is basically guidelines for assembling the product while the product passes an operator. The SOP currently is a printed board at assembly floor which is needed to be digitalized for the JCB Company. The SOP will be completely displayed along with requirements of the material. The necessity is that when SOP is displayed, the bins (storage boxes) must have the correct part boxes marked with the help of LCD and the quantity of those specific parts displayed on the LCD. The operator thus can easily make out the necessary parts and pick the correct quantity without having to hunt for the items.

Key words: Assembly Line, Automation, Production, Embedded, Controller, Digitalization, SOP (Sequence of Processing)

I. INTRODUCTION

The project is a requirement from the J.C. Bamford company which is a leading industrial manufacturer of large vehicles and equipments. The assembly line requires a SOP. The operator thus has to follow the fixed sequencing to pick their required materials in right quantity, and assemble the product, and pass it further. As the SOP needs to be digitalized on the computer display based accounting process system , under this, the SOP will be loaded on the computer by the technician for each specific model. The requirements of materials will be displayed on the screen. The assembly line also has a bin that stores sorted small parts into small boxes called bins. As the SOP is displayed, the bins must have the correct material marked on the LCD specifying the quantity of the required parts. The display is attached on the bin. The sorting of items become easy. The larger items, on the other hand are labeled with barcodes that may be scanned via the reader connected to the PC on which SOP application is loaded. As the tasks within the SOP are completed, the SOP checks the items by tick marking tasks completed in the list automatically and further instructions are provided on the display itself. For record and log generation, the application then generates a record or log file that has complete details of work completed by operator, along with time stamp of completion.

II. TECHNICAL DESCRIPTION

A. Software:

The hardware needs to be programmed being an embedded system, the board and theATMega328P chip needs to be dumped with code and also application is essential.

1) Embedded C:

The embedded C programming is done as the C language can be easily used for programming as it can also be referred to as a high level assembly language, the code is dumped in the chip for board programming which helps in delivering the output on the display.

2) PC App:

An application compatible to run on a computer is required for processing the output on the PC screen. Java application is executable for the SOP display which can help in the conformation of work done and for sending serial commands over the USB.

3) Connectivity:

The USB Board driver's helps in easy connectivity of the system to the PC and the application the drivers efficiently used are serial drivers by RxTx- rxtxserial.dll and arduino nano drivers.

B. Hardware:

1) LM 2596 DC-DC buck converter:

The buck converter controls the voltage fluctuation in the circuit and works with a +5 V DC power supply.

2) ATMega328P board:

The ATMega328P is a microchip. The microchip operates between 1.8-5.5 volts. The chip works as a motherboard of the system which has pico power of 8 bit AVR RISC- based microcontroller. This also helps in converting the analogue signal of the sensors gesture to digital display.

3) LCD display:

The 16*2 Liquid crystal display screen displays the required procedure to be followed in the process. The screen here shows the SOP, number of the bin, and quantity of the parts to be picked up.

4) IR sensor:

The IR sensor used is a FC-51. The sensor works with infrared system which can judge the heat of any object and motion as well. So, the sensor sense the hand gestures of the employee and returns the signal.

5) Compatibility:

Windows compatible PC with USB 2.0 connectivity port.

III. ILLUSTRATION

The connectivity of the IR sensors is directly made to the bins placed in the product assembly. The bins basically are filled with the tools and parts used by the worker to establish the machine. The bins have a definite count of the parts required for assembling the machine, the worker as and when takes any part out form the bins it will be automatically registered and tracked by the sensors ensuring to send the signals to the display as shown in the figure (1). The SOP automated in the system will ensure the procedure of the items being used. By now the SOP's have been in the form a printed board this will digitalize the SOP on a display screen of the computer which will make it more easier for the worker to carry out his work as well as for the system to identify if any errors takes place.

The JAVA application will run on the computer sending the SOP command through a serial USB port ensuring connectivity. The ATMega328P chip is programmed in order to accept the SOP commands and to display it on the LCD attached to the product. The process passes on to the selection of SOP product. Certain sequence will be already entered in the system so that the required parts for the machine will be available in the bin and the SOP will perform the procedure accordingly, when the Sequence is ready and the worker performs certain tasks with the bins the IR sensors will sense the hand gestures and accept the use of parts. But if the hand gestures are not detected the worker will be bound to do the work again as the system will not read any of the action which took place. After successful access the bin data and steps will be updated instantly on the display.

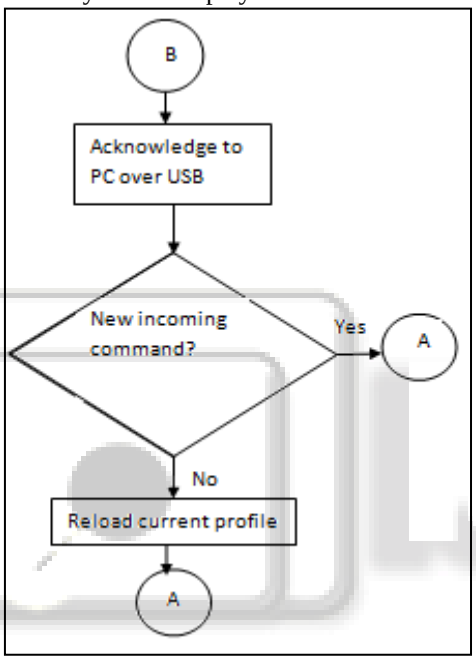

Fig. 1: Flowchart-1 of the System

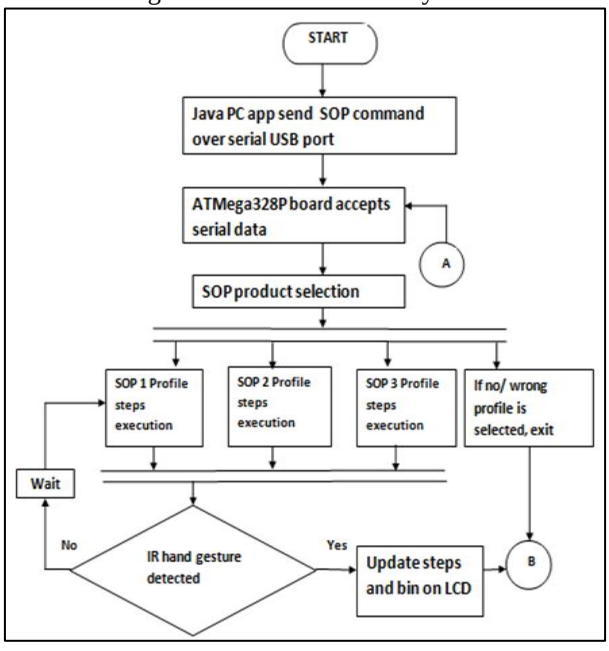

Fig. 2: Flowchart-2 of the System

IV. RESULT

The IR sensors here are connected with the bins which sense the hand movements while taking the parts out of the bins.

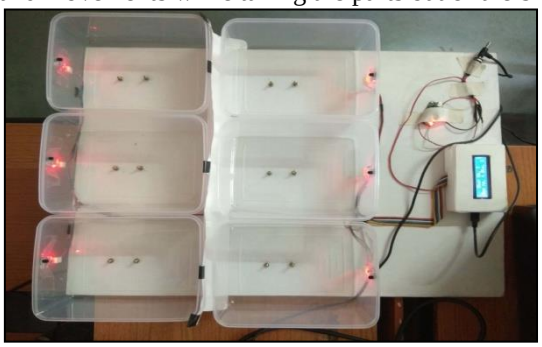

Fig. 3: System view

The LCD shows the SOP and the steps to be processed with the bin numbers as box numbers and the quantity of the items in the bins.

Fig. 4: LCD

V. CONCLUSION

With an ample amount of study the product assembly became possible. The application to be implemented on the computer screens is written in JAVA. The product assembly is carried out with bins and programmed ATMega328P which gives the SOP instructions on the display screen as a result the product in the assembly line can be prepared with instant measures of objects used for making the product through the LCD display.

VI. FUTURE SCOPE

The implied work can be scanned using a bar code reader which will enhance the product usability. The connectivity hence forth can be more secured also Profinet protocol is one more thing in the lime light. Feedback of the tools torque can be generated.

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