Beaglebone Black with CODESYS

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***Abstract*—This report contains information about establishing connection to Beaglebone Black(BBB) through CODESYS and using it as Programmable Logic Controller(PLC) accessing its Input/Output(IO) ports.**

I. Starting Up

Firstly, the board should be connected through USB port to PC and open up CODESYS. In order to be able to run CODESYS programs on BBB it is necessary to install the special Plug-in from CODESYS Store Figure 1.

Fig. 1. BBB Plug-in for CODESYS

When creating new Project in CODESYS, from the Device list, Control for **BeagleboneBlack SL** should be chosen as working device (Figure 2).

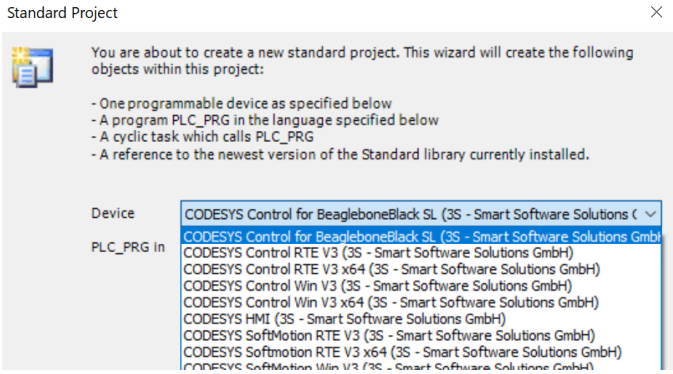

Fig. 2. Device when creating project in CODESYS

After the project is created, in the Project view Setting for BBB window will appear as in Figure 3.If it not appeared, go to **Tools** and click **Update Beaglebone Black**. Where we need to write username (**debian**) and password (**temppwd**) which are default for BBB. Also, the IP adress **192.168.7.2** is default for the board.

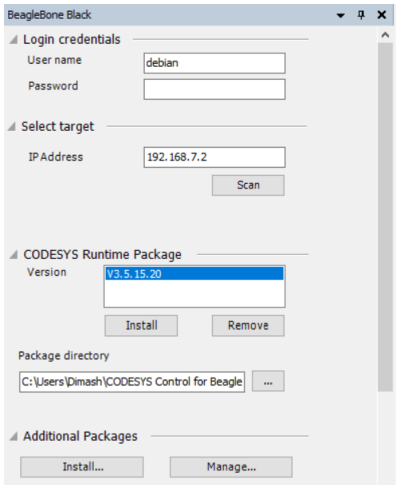

Fig. 3. Device when creating project in CODESYS

After entering all necessary information, we press **Scan button** and choose the BBB from the list. If there is only one device connected to PC it will be seen from the list. We choose it and press **Install** button. System will report that packages on BBB are installed (Figure 4).

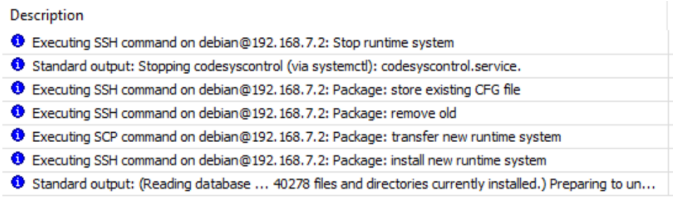

Fig. 4. CODESYS messages list when Installing on BBB

II. Settings and Establishing connection

When device is installed, we can plug device in order to access its ports and addresses. Right Click on $< Empty >$ in Device list and click **Plug Device** Figure 5.

Window with accessible devices will appear Figure 6

Choose the **GPIOs P9/P8** and click **Plug Device** button. After which it will be in the list of the devices.

As devices are settled, the PC can be connected to PLC from Device setting. Where **Scan network...** button should

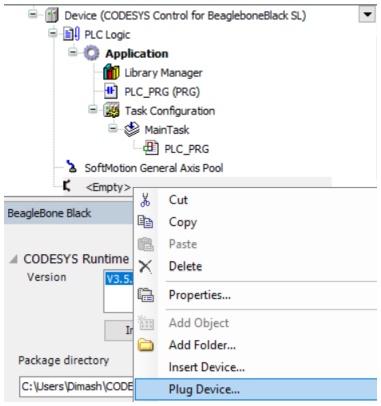

Fig. 5. Plugging device

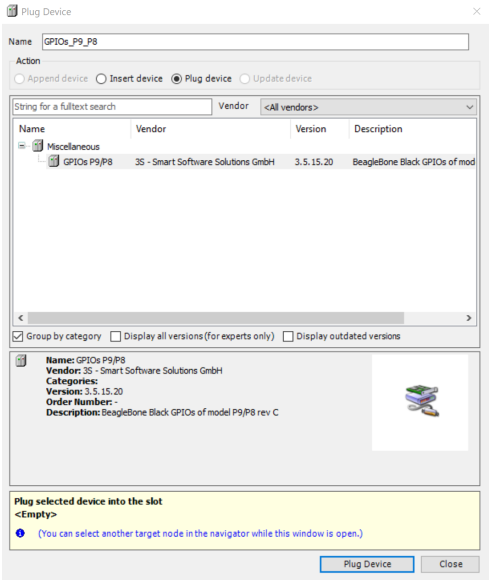

Fig. 6. List of devices to plugin

be pressed. From the list, choose device and click **Ok** button Figure7.

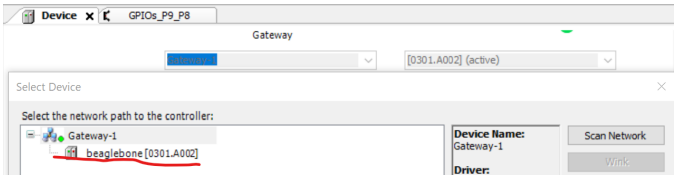

Fig. 7. Connecting to BBB

III. Codding the board as PLC

The last step is to create code and run it on BBB. Simple program can be crated as an example. Beaglebones Pins can be used as Inputs as long as Outputs. The pin-outs can be found from Figure 8. All the pins which are tagged as **GPIO_NN** can be used for programming.

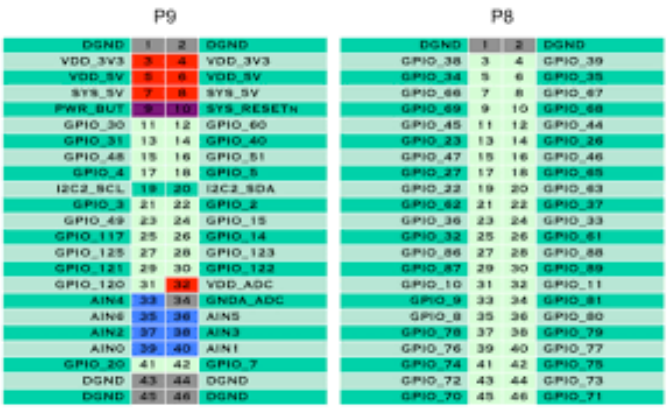

Fig. 8. BBB pin outs

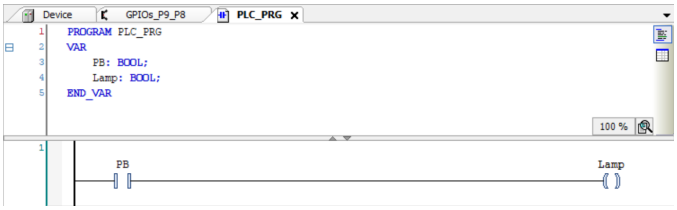

Fig. 9. BBB pin outs

Simple program with one input and one output is created in LD language as example (Figure 9).

As the variables are created. Those should be associated with pins of BBB. Proceed to **GPIOs_P9_P8** tab. Where in the parameters of the pins we can set the values of the pins that are going to be used as **Input** or **Output**. For example, we want to use **pin 8** in slot **P8** to get input from the button. So, we set GPIO_67 as **Input** and GPIO_68 as output for the lamp which is located on **pin 10** (Figure 10).

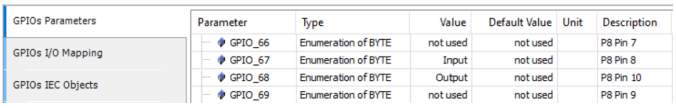

Fig. 10. Setting up Input/Output pins

After that, variables should be associated with corresponding pins. In the same tab, we go to **GPIOs I/O Mapping** where is separate lists for inputs and separate lists for outputs. As our GPIO for input is 67. We go to **digital inputs 64-95** and extend it, from the list choose respective pin (GPIO_67) and double click to choose variable (Figure 11). The same is done for output.(IMPORTANT to not mix up **digital outputs** list with **digital inputs** list)

After the pins are associated. The program can be ran and tested on hardware.

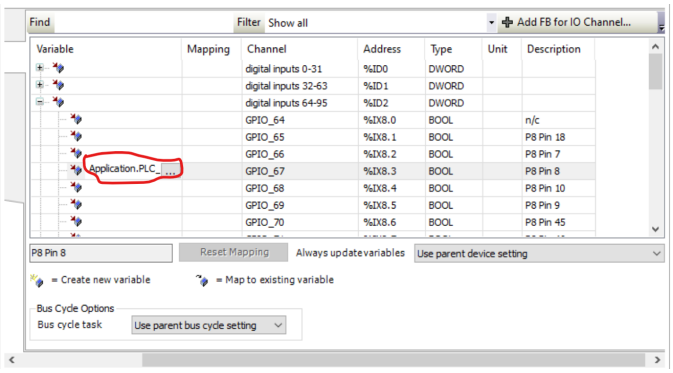

Fig. 11. Associating variables with pins

IV. WEB VISUALIZATION

Firstly, the visualization of the system should be created. Then, **WebVisu** is automatically created. So it can be accessed by entering the following address
192.168.7.2:9090/webvisu.htm
in browser. The board can be connected to the internet network so it will be possible to access its web visualization from anywhere in the world. However, University WiFi blocks such connections which is why we are restricted by only local network from own router.

V. CONCLUSION

It is turns out that CODESYS software can be used not only with different PLCs but with boards such as Arduino or Raspberry Pi. It is very useful when it comes to learning the PLC programming. It is good opportunity to see all processes in hardware. Moreover different implementation for IoT can be made tested and implemented.