Software Specification

Aleksandr Popov
0924595
a.popov@student.tue.nl

Devin van Broekhoven
0839004
d.v.broekhoven@student.tue.nl

Jiddo van Vliet
0821894
j.g.v.vliet@student.tue.nl

Yuntao Li
0910663
y.li.2@student.tue.nl

Dan Cristian Chirascu
0923784
d.c.chirascu@student.tue.nl

Group 17

April 14, 2015

1 Introduction

This document discusses the requirements for the future PP2 Assembly program code for the sorting machine project. It also describes in detail how the machine and software should work depending on given inputs.

2 Inputs to the Program and Machine Interface

In this section inputs to the program are given in order of their use in a standard iteration for soritng 1 disc. These inputs correspond to items described in Machine Interface.

1. Dispenser button
   - Positioned next to the dispenser engine
   - Used to detect the current position of the dispenser
   - Gives a high signal if button is pressed
   - The dispenser will press the button in its most retracted state
   - Corresponds to PP2 input 3
2. Presence detector
   - Positioned below the loading tube
   - Used to detect if there are discs left to sort
   - Gives a high signal if no discs are left, gives a low signal if there are discs detected
   - Corresponds to PP2 input 1
3. Black/white detector
   - Positioned above the discs, after Presence detector and right before the disc falls onto the conveyor belt
   - Used to determine if a disc is black or white
   - Gives low values on white discs, gives high values on black discs
   - Is connected to PP2 A/D Converter input
   - Corresponds to lower 8 bits in register `ADCONVS`
4. Side detector: white tray
   - Positioned at the end of the conveyor belt where the white discs leave the belt and go into a storage box
   - Used to detect if the white disc has been delivered by the conveyor belt
   - Gives a high signal on no disc, gives a low signal when a disc is detected
   - Corresponds to PP2 input 0

5. Side detector: black tray
    - Positioned at the end of the conveyor belt where the black discs leave the belt and go into a storage box
    - Used to detect if the black disc has been delivered by the conveyor belt
    - Gives a high signal on no disc, gives a low signal when a disc is detected
    - Corresponds to PP2 input 2

3 Outputs from the Program and Machine Interface

In this section outputs from the program are given in order of their use in a standard iteration for soritng 1 disc. These outputs correspond to items described in Machine Interface.

1. Dispenser engine power
    - Positioned over the conveyor belt
    - Used to distribute 1 disc at a time to the black/white detector, and then to the conveyor belt
    - Is connected to PP2 output 0
2. Presence detector lamp power
    - Positioned below the loading tube.
    - Powers the light for the presence detector
    - Is connected serially with two more lamps to PP2 output 4
3. Black/white detector lamp power
    - Positioned above the discs, after the presence detector and right before the disc falls onto the conveyor belt
    - Powers the light for the black/white detector
    - Is connected to PP2 output 2
4. Conveyor belt engine power
    - Positioned just next to the conveyor belt
    - Used to power the conveyor belt to go in either right or left direction
    - Polarity of this output can be inverted to invert the motion of the engine and thus change conveyor belt direction
    - Corresponds to PP2 output 6 (to go right) and 7 (to go left)
    - Outputs 6 and 7 must not be high at the same time

5. Side detector lamp power: white tray
   - Positioned at the end of the conveyor belt where the white discs enter the storage box
   - Powers the light for the side presence detector
   - Is connected serially with two more lamps to PP2 output 4
6. Side detector lamp power: black tray
   - Positioned at the end of the conveyor belt where the black discs enter the storage box
   - Powers the light for the side presence detector
   - Is connected serially with two more lamps to PP2 output 4

4 Input and Output relations

1. Dispenser engine power
   The engine for the disc dispenser will always go to its most retracted state on its first use. This is checked by reading the signal from the button attached to the dispenser. When the button is pressed the dispenser will start turning until it is pressed again. If the button is not pressed it will also turn until it is pressed. After the first rotation it will depend on the input from the *Presence Detector*. When the *Presence Detector* detects a disc (gives a low signal) the engine will make another rotation in the next cycle. If it does not detect a disc (gives a high signal) the engine will finish its rotation but will stop in the next cycle. Same behaviour should be employed when a user presses the *Start/Stop Button* while the machine is running. If *Abort Button* is pressed, power should be cut off immediately (within 15 ms).
2. Conveyor belt engine power
   The engine for the conveyor belt will only turn if the *Presence Detector* has detected a disc and the *Black/White Detector* has detected its color. For white discs the *Black/White Detector* will give a low value (¡ 90) and for black discs it will give a high value (¿ 100). Depending on the signal for the *Black/White Detector* the engine for the conveyor belt will either turn left or right to deliver the discs to their appropriate trays. If the user presses the *Start/Stop Button* while the machine is running, the conveyor belt will run until it delivers the last disc or until an exception occurs (i.e. disc has not been detected on time). If *Abort Button* is pressed, power should be cut off immediately (within 15 ms).
3. Side presence detector white/black tray
   The Side presence detector for white or black tray detects if a disc has been delivered to a tray. If a disc passes the detector it will give a low signal, when no disc passes the detector it will give a continuous high signal. If the detectors have not given a low signal in a certain time interval all other components of the machine will stop immediately as if the user pressed *Abort Button* (within 15 ms).

4. Lamps
   All the lamps are turned on after the initialization phase. The are later turned off only if the user presses *Abort Button* or if an exceptional situation occurs. In that case power to the lamps cuts off within 15 ms.

5 Abstract States and Dependencies in the Model of our Program

For our model we will use a starting state which is also the halting state, resting state and multiple running states.

In this section we need to answer two questions:
How does the state of the machine change in reaction to (changes in) the inputs?
How do the outputs depend on the inputs and on the current abstract state, that is, what is the required reaction of the PP2 to (changes in) the inputs?

1. Our first state is the starting state, but also the halting state. In this state none of the outputs should be high, and signals coming from inputs are ignored, except for the Start/Stop Button.
   - When powering up the machine will be in this state.
   - When pressing the abort button from any state it will immediately go to this state.
   - Going to the next state is only possible by pressing the Start/Stop Button.
2. The second state is the resting state. In this state the machine will put the dispenser into the correct position so an output is high for the dispenser engine. None of the other inputs and outputs will give any signal.
   - If the Start/Stop button has been pressed in any of the other states except the first state it will return to this state at the end of the cycle.
   - Going to the next state is only possible by pressing the Start/Stop button.
3. The third state is the running state. In this first running state the machine detects if there is any disc left to sort. The only input checked by the PP2 controller is that of the presence detector. The only output is the power of the lights for the detectors.
   - If a disc has been detected the machine will go to the next state.
   - If no disc has been detected the machine will go to the 2^{nd} state.
4. The fourth state is the second running state. In this state an output will be send to the engine of the dispenser.
   - After a time-based event the machine will go to the next state.

5. This is the third running state. An input from the black/white detector will be checked by the PP2. This input will be used in the 7^{th} state.
   - After a time-based event the machine will go to the next state.
6. The fourth running state. An output is high for the dispenser engine.
   - After a time-based event the machine will go to the next state.
7. The fifth running state. The input from state 4 is used to determine the next state.
   - If the input from state 5 is high go to state 8 A.
   - If the input from state 5 is high go to state 8 B.
8. (a) The sixth running state. An output for the conveyor belt engine to turn it right is high until either a disc has been detected at the presence detector white or the time limit has been exceeded.
      - If the input from the side presence detector was low go to state 3.
      - If the time limit is exceeded go to state 1.

   (b) The sixth running state. An output to the conveyor belt engine to turn it left is high until either a disc has been detected at the presence detector black or the time limit has been exceeded.
      - If the input from the side presence detector is given go to state 3.
      - If the time limit is exceeded go to state 1.

For more formal version of the specification discussed above please refer to the UPPAAL model that comes with this document.