

User Manual

Monorail Emulator

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# Board Setup

The table below displays the general port connections.

Table 1 General Port Connections

|  |  |
| --- | --- |
| Devices | Pin |
| KEYPAD | PL0–PL3 => C3–C0  PL4–PL7 => R3–R0 |
| LED | PC0–PC7 => LED2–LED9  PG2–PG3 => LED0–LED1 |
| MOTOR | PE2 => Mot  TDX2 => OpO  PA3 => LED  +5V => OpE |
| PUSH BUTTONS | RDX3 => PB1  PDX4 => PB0 |
| LCD | PF0–PF7 => D0–D7  PE5 => BL  PA4 => BE  PA5 => RW  PA6 => E  PA7 => RS |

# Operating Instructions

## 2.1 System Configuration

The following steps outline the process which configures the system.

### 2.11 Step 1: Enter number of stations

The LCD display will appear as follows:

|  |
| --- |
| **STAT NUM:** |

In this step, the user must input the number of stations. The maximum number of stations that can be entered in 10. During this sequence only the number buttons will work. Buttons A, B, C, D and \* will be disabled to prevent input of incorrect data structure. The following table displays how different error cases are handled.

Table 2 Error Cases for Number of Stations

|  |  |
| --- | --- |
| Error Case | Input Result |
| Enter 0 or 1 | 10 |
| Enter number larger than 10 and is a multiple of 10 (eg 20, 30, 40) | 10 |
| Input number larger than 10 but not a multiple of 10 (eg 16, 32, 21) | Input is last digit of number |

To confirm number of stations, the # key needs to be pressed. Note that a maximum of 7 digits can be entered.

### 2.12 Step 2: Enter name of each station

The station name can be a combination of characters and white spaces where the maximum number of characters is 10.

Keys A, B, C, D are to represent characters on the number keys. To enter a character, you must first press either A, B, C or D and then select the number key, which will print the associated character on the LCD screen. For example, to select the character “J”, A must be pressed followed by the number key 5. You can observe that J is the first character on the “5” key, which corresponds to key A. A white space is given by the \* key. Note that D only works on keys 7 and 9. Note that pressing on any of the number keys without first pressing A, B, C, D will not work so that incorrect data structures aren’t inputted. The following table outlines the functioning of this step.

Table 3 Functionality of buttons in step 2

|  |  |
| --- | --- |
| Button | Function |
| 2-9 | Enter Characters |
| # | Finish inputting and store name |
| A | Represents first character on key |
| B | Represents second character on key |
| C | Represents third character on key |
| D | Represents fourth character on key |
| \* | White space |
| 0/1 | Will not work |

When the # button is pressed, the name is stored and characters left over will be replaced with white space. After this, the program will be taken to the next stage in configuration.

### 2.13 Step 3: Entering Travel time between stations

The LCD screen will display:

|  |
| --- |
| SN TO S(N+1) |

Where N is the station number.

In this step, the travel time, in seconds, between stations is inputted. The maximum travel time is 10 seconds. Error handling is exactly the same as with the number of stations. For error handling cases refer to Table 2. After the correct travel time is inputted, press # to store and move to the next stations. Note that in a similar fashion, the maximum number of digits entered is also 7.

Table 4 Functionality of buttons in step 3

|  |  |
| --- | --- |
| Button | Function |
| 0-9 | Enter number stop time |
| # | Finish inputting and store number of stations |
| A | Will not work |
| B | Will not work |
| C | Will not work |
| D | Will not work |
| \* | Will not work |

### 2.14 Step 4: Enter stop time

The LCD screen will display:

|  |
| --- |
| STOP TIME SN |

Where N is the station number.

In this step, the user must configure the stop time of the monorail stations individually. The minimum time for stopping is 2 seconds while the maximum stop time is 5 seconds. Like Step 1 and Step 3, only the number keys and # button will be available to prevent input of any incorrect data structures. When a correct stop time is inputted and # is pressed, the program will store the value and move to the next station.

The following table outlines how different error cases are handled.

|  |  |
| --- | --- |
| Error Case | Input |
| Input < 2 | 2 |
| Input > 5 and 1 digit in length | 5 |
| Input > 5 and more than 1 digit in length | Last digit taken into account, the last digit is then handled like the first two error cases. |

Note that the maximum digit that can be entered is 6. After the 6th digit, nothing else can be entered and the user must press #. After the stop time of all stations have been entered, the configuration phase of the emulator has finished and the board will start to simulate the action of a monorail.

## 2.2 Monorail Emulation

After configuration of the system has completed, the emulation begins. When this phase occurs, the LCD screen will display as follows:

|  |
| --- |
| OK WAIT |

When waiting at a particular station (this is to emulate stop time).

|  |
| --- |
| NEXT STATION |

When travelling to the next station.

After waiting for 5 seconds, the motor will start spinning at a speed of 60 revolutions per second. This is to represent the motor moving. At this stage, the LCD screen will display the name of the next station and the travel time associated with it.

PB0 and PB1 are to simulate the embarking or disembarking of a tourist at the next station. When one of them is pressed, the monorail will stop at the next station. Otherwise there is no change in passengers and so the monorail will continue to the next station.

The # key is to simulate an emergency stop of the monorail. After stopping, pressing the # key again will resume travel. Moreover, when the monorail is halted, two LEDs will blink at a frequency of 3Hz and will stop blinking when the monorail resumes its movement.