

# Helicopter Simulator

## User Manual

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### Setting Up the Lab Board

In order to run the helicopter correctly please see the following table which describes the pin configuration of the lab board.

PORT NAME	PIN NUMBER	PORT NAME	PIN NUMBER
PORT A	PA7	LCD CTRL	RS
	PA6		E
	PA5		RW
	PA4		BE
PORT F	PF0	LCD DATA	D0
	PF1		D1
	PF2		D2
	PF3		D3
	PF4		D4
	PF5		D5
	PF6		D6
	PF7		D7
PORT K	PK8	LED BAR	LED9
	PK9		LED8
	PK10		LED7
	PK11		LED6
	PK12		LED5
	PK13		LED4
	PK14		LED3
	PK15		LED2
PORT C	PC7	KEYPAD	R0
	PC6		R1
	PC5		R2
	PC4		R3
	PC3		C0
	PC2		C1
	PC1		C2
	PC0		C3
INPUTS	PB0	PORT D	RDX4
	PB1		RDX3
MOTOR	Mot	PORT L	PL4

## **LCD Display Information**

The LCD shall, at different times of the simulation display different information. This section will explain how to interpret this information.

When the board is first connect to the power or when the user presses the RESET button. The LCD shall display the message “START:” this means the helicopter is ready and waiting for the user to begin the simulation.

When the simulation has begun the board will show two lines of text. The following table shows each piece of text, location on the LCD and how it should be interpreted.

TEXT	LOCATION	MEANING
POS	Line 1 – Right hand side	Position
DIR	Line 1 – Middle	Direction
SPD	Line 1 – Left hand side	Speed
xx,yy,zz	Line 2 – Left hand side	When the board is running. xx,yy,zz will be replaced by numbers. For xx and yy these numbers range from 0 to 50. For zz the numbers will range from 0-10. These numbers are the associated x,y,z coordinates in the simulated room that is 50x50x10 meters squared.
d	Line 2 – Middle	When the board is running, d will be replaced alphabetical characters which indicate in which direction the helicopter is supposed to be moving. Below is a list of the possible letters and there meanings:  H – Not moving/Hover mode U – Up D – Down F – Forward B – Back L – Left R – Right
(x)ms	Line 3 – Right hand side	When the board is running x shall be replaced by a value that ranges from 0 to 4. This value represents the speed of the helicopter in meters per second. E.g. 2ms = 2 meters per second

At the end of a successful flight the LCD screen shall change and show the following words:

DISTANCE: xxxx m

DURATION: yyyy s

Distance is the total distance, in meters, covered by the helicopter whilst flying around the room. Duration is the total flight time, from take-off to landing in seconds. Both values for distance and duration theoretically range from 0~9999.

## **Button Information**

During the course of the simulation, you will want to make changes to the helicopters speed, direction or even flight mode. The following table list the buttons used to manipulate the helicopter and a short description of their function.

<b>BUTTON NAME</b>	<b>DESCRIPTION</b>
PB0	Increases the speed of the helicopter by 1
PB1	Decreases the speed of the helicopter by 1
Keypad 1	Helicopter travels in a upwards direction
Keypad 2	Helicopter travels forward
Keypad 3	Helicopter travels in an downwards direction
Keypad 4	Helicopter goes to the left
Keypad 6	Helicopter goes to the right
Keypad 8	Helicopter travels backwards
Keypad #	Turns on/off the helicopters hover mode
Keypad *	Press once to take off, press again to make the helicopter land
RESET	Resets the simulation.

## **How To Guide For Running The Simulator**

This section shall describe the conditions and boundaries of the simulation, how to successfully fly the helicopter and further detailed descriptions on how the components of the lab board function during take-off, flight and landing.

The conditions and boundaries of the simulation are as follows:

- The x and y axis of the simulated room have a minimum value of 0 and a maximum value of 50. Trying to go past these values will result in the helicopter crashing into the walls.
- The z axis of the simulated room has a maximum value of 10. Reaching this value means the helicopter has crashed into the roof. The minimum value of the z axis is 0. If the helicopter reaches this point it will have landed.
- If the helicopter crashes the LED lights will flash on and off and the LCD screen will display the last location, speed and direction the helicopter had. In order to fly the helicopter again the simulation must be reset
- If the helicopter lands, the LCD screen will display the total time the helicopter was flying and the total distance the helicopter flew while travelling around the room. In order to fly again the simulation must be reset
- When you change the speed of the helicopter, by pressing PB0 or PB1, the change in speed and the time before you can press either button again will take 0.5 seconds. Please

note this delay as you might have difficulties trying to slow down as you approach a wall or the ceiling. It is advised that you instead change directions and then slow down.

- When you press the \* button on the keypad to descend, please be aware that you will not be able to change the direction or the speed. In order to stop the landing procedure you will have to press the \* again to initiate another take off.

Once the lab board has been successfully wired, powered on and the simulation program has been flashed onto the microprocessor unit, the LCD screen will display the message “START:”. To begin the flight of the helicopter press the \* button to take off.

When the helicopter is taking off, it will be travelling upwards at 2m/s. We warn the user that due to the low ceiling height of the simulated room that the direction of the helicopter should be changed as quickly as possible to avoid crashing into the ceiling. Before taking off the user will not be able to interact with any part of the board besides the take off button. Once you have taken off you are free to change your speed, direction or engage in hover mode.

When you press PB0 you will increase speed by 1m/s, with the maximum being 4m/s and when you press PB1 you will decrease speed by 1m/s with the minimum being 1m/s. These changes will be noted on the LCD screen under the sign of “SPD”. As you change the speed of the helicopter this will be reflected in how fast the motor spins. When the helicopter is not running, landed or crashed the motor will not spin. Since the helicopter has 4 speeds so too does the motor.

When changing the direction, the user can make the helicopter move horizontally along the x-axis, laterally along the y-axis and vertically along the z-axis. Pressing left will decrease the number associated with the x-axis on the screen and pressing right will increase the number. Pressing forward will increase the number associated with the y-axis on the screen and pressing back will decrease the number. Pressing up will make the number associated with the z-axis increase and pressing down will make the number decrease. The direction that the helicopter is travelling in will be printed on the LCD screen under the sign “DIR”.

When you press the \* star button, the helicopter will engage in hover mode. Hover mode will make the helicopter stop moving until the button is pressed again to disengage the mode. When mode is disengaged, the helicopter will fly in the same direction and speed that it was flying before. Also to note that is while the helicopter is hovering you cannot change the speed or direction. However mode is represented by the letter “H” appearing under the “DIR” sign of the LCD screen.

After flying the helicopter around the room, when you want to land, you have two options. Option one is to press the take-off button a second time to make the helicopter enter into landing mode. In this mode the helicopter will travel downwards at a speed of 1m/s. Option two is to press the down button and the helicopter will descend to the ground at the speed it was travelling before the button was pressed. After a successful landing, the LCD screen will display the total time, in seconds, the helicopter was in the air and the total distance, in meters, the helicopter travelled. The lab board can accurately display up to 9.999km of total distance and 2.7 hours of flight time. The user can run the helicopter longer and further than this if they wish but beyond these values, tracking is no longer accurate.

These are the basics of the helicopter simulation. We hope you enjoy our product and wish you a safe flight.