

## 1. Introduction

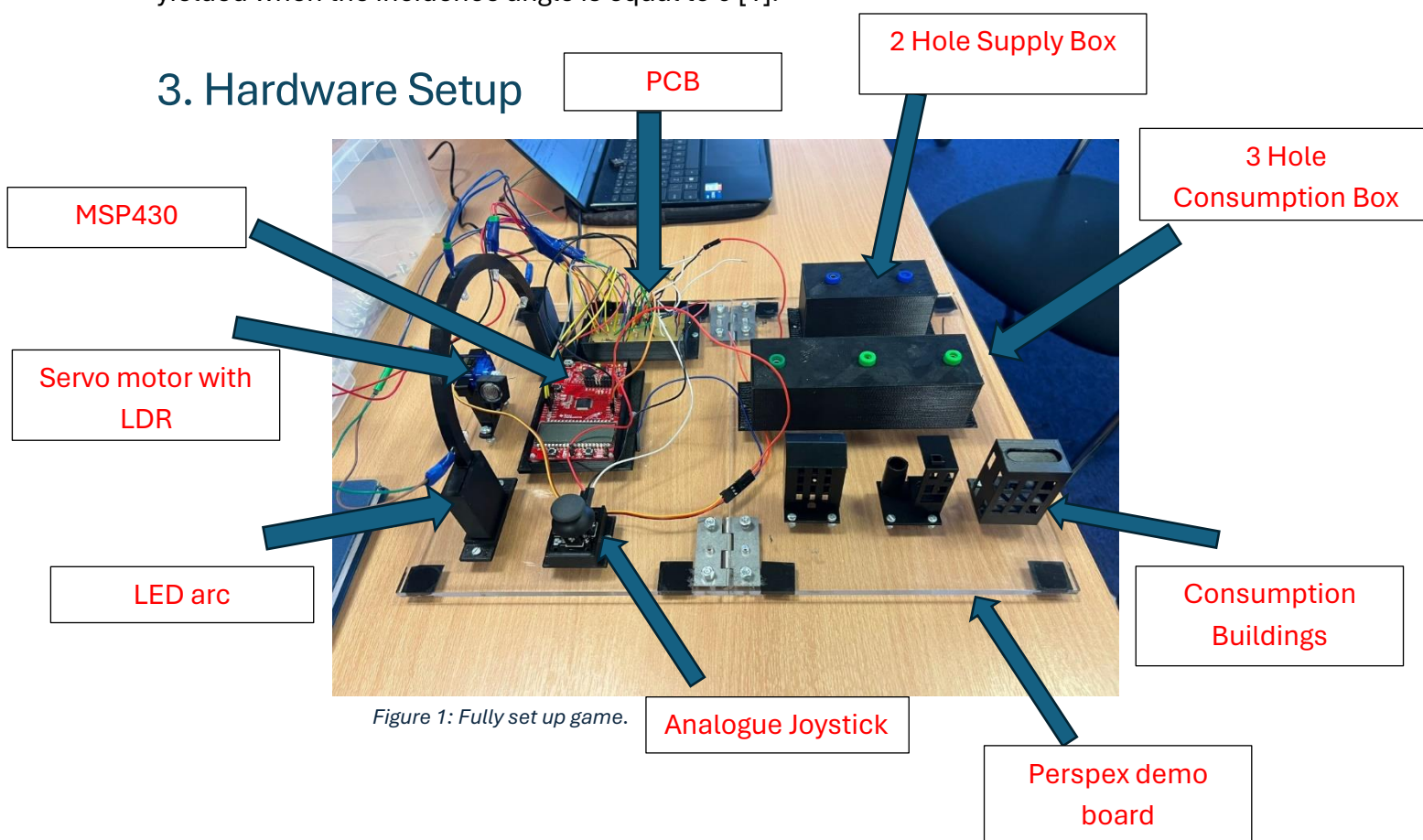
This user manual will guide you through the steps required to set up the Mini-Grid Game, the game operation, and how to tidy it away. Before opening the box, ensure to read the instructions thoroughly - this will prevent wire and tape connections from breaking.

## 2. Background Theory

### 2.1 Relation to Sustainable Development Goal 7

Our assigned Sustainable Development Goal was SDG 7 – clean and affordable energy. The Mini-Grid game explores one of the SDGs main targets of universal access to modern energy and sheds light on the difficulties of accessing clean and renewable energy in developing counties – something that we take for granted in the western world. This serves as a teaching point in the demonstration, educating the users on real-world engineering problems. In essence, the game captures the main themes of a PowerGrid and aims to educate the users on the basic elements of generation, distribution and transmission. The game also taps into the engineering behind solar panel operation whereby more power is yielded when the incidence angle is equal to 0 [1].

## 3. Hardware Setup





Please read all instructions fully before plugging and powering any devices (MSP430 and plug). For any guidance on how the layout should look before commencing the game, please refer to Figure 1.

## 3.1 Setting up Player 1

1. Carefully, place hands on both sides of the bottom of the Perspex demo board and lift out of the box.
2. Next, unfold the bottom half and lay the entire board on a flat surface. Note: be careful of the surface that opens out as it can swing out abruptly.
3. Place the LED arc screws into their respective holes – the arc should stand upright by itself if done correctly.
4. With multiple hands, locate the side with the servo motor closest to it and tilt the board up, exposing the screws on the underside of the board.
5. Obtain the bolts from the pink bag, and screw from the underside of the board until screwed tightly.
6. Once secure, you can place the board flat on a surface again.

## 3.2 Setting up Player 2

1. Locate the 2 Hole Supply Box and 3 Hole Consumption Box.
2. Find the blue bag and take out the screws and bolts.
3. Line up the screws with the holes of the boxes and put them through the demo board – the boxes should be relatively stable if this is done correctly (**it is worth mentioning that the wires stemming from the holes are not part of the project and should be ignored**)
4. From the Player 2 side, gently tilt the board until the bottom is exposed.
5. Using the bolts obtained from the bag in Step 2, screw the bolts until they are a tight fit.
6. Locate a nearby socket and make a connection between the PCB barrel hole and the socket – ensuring that the socket is off in this step.
7. Power the MSP430 with a USB connection to a laptop.
8. Turn the socket on, run the code on the laptop provided, and enjoy the game 😊.



## 3.3 How to play the game

- Once everything is set up and powered on, run the code on the laptop provided.
  - If a laptop is not provided – the following the link will grant access to the project repository. The code files are named with the prefix “fully\_commented”. An embedded C IDE is required to execute the code. The link can be found [here](#)
- Now run the code. The LCD screen should display “MINI GRID GAME” to indicate the start of the game.
- Use the joystick to control the solar panel movement – you should try follow the sun path as best as possible.
- When the game timer ends, “GAME OVER” will display on the LCD screen.
- Your final score is displayed at the end.
- To play the game again – rerun the code and enjoy.

## 4. Putting it back into the box

1. Turn the socket off at the wall, unplug the USB cable from the laptop, and disconnect the plug from the barrel hole connection in the PCB.
2. By the same method used to screw the holes, unscrew the 2 Hole Supply Box and 3 Hole Consumption Box and return to its respective plastic bag.
3. Put screws and bolts back into their respective bags
4. Place the 2 Hole Supply Box and 3 Hole Consumption Box into the large transparent container ensuring that the boxes are packed flush with the container walls as shown in the diagram. A Photo is provided in Figure 2.
5. Unscrew the bolts at the bottom of the LED arc but make sure to not take the screws out (leave it as you found it). Put the bolts back to their respective coloured bag.



Figure 2: Supply and Consumption box layout



6. With the Player 1 Generation side facing upwards, fold the other side beneath and place into the box.
7. With the demo board sitting in the container, gently lift the LED arc and tilt it forwards such that it is nearly lying flat on the rest of the board. Figure 3 illustrates the final box layout before closing the lid.
8. Close the box lid, secure the side using the latches, and store it away.



Figure 3: Demo fully packed away

## 4. Expected Results

If the steps have been correctly executed, you would expect a working Mini-Grid Game driven by an MSP430 using a working PCB to map connections. The game begins with the LED (which mimics the sun) stimulating the LDR mounted servo motor (mimicking a solar panel) which is controlled by the analogue joystick on the Player 1 Generation side. A score will be calculated based on an algorithm encoded in the MSP430 and this will be displayed on the LCD display as the game progresses – note the score sensitivity may lag due to ADC channel switching complications.

Unfortunately, the Player 2 Consumption side was not fully implemented, hence its exclusion in the final demonstration. This stemmed from several issues regarding group members and unexpected complications with the PCB.

### 4.1 Debugging and potential issues

Ensure that the servo motor arm is attached such that all LEDs can be reached. If this is not the case, manually disconnect and reattach the servo motor arm to fix this offset.

## 5. References

- [1] “Solar trackers: What they are, types, and advantages,” *REPSOL*.  
<https://www.repsol.com/en/energy-and-the-future/future-of-the-world/solar-trackers/index.cshtml#:~:text=The%20operation%20of%20solar%20trackers> (accessed May 13, 2024).