A battery charger from the PV Panel by using the MPPT converter

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1 INTRODUCTION

The main objective of this work is to design a Maximum Power Point Tracking (MPPT) board. The MPPT board is actually a DC-DC converter board. Therefore, various types of DC-DC converters were investigated and it was determined that the most suitable option for the PV panel and battery to be used was a boost converter.

The necessary calculations and component selections were made for the boost converter. The design was completed using the Altium Designer program.

The types of algorithms used to find the maximum power point of the panel were examined and it was decided to use the Perturb and Observe algorithm.

2 METHOD

In this diagram we have an inductor, a capacitor and two solid-state devices. When the MOSFET is turned on, the diode will disconnect the capacitor and load from the input voltage, and the input current will flow through the inductor and inductance stores energy. When the MOSFET is turned off, the diode will conduct. Hence the input voltage source will be connected to the output capacitor and load. The current flowing on the inductor will be directed to the output capacitor and load through the diode. The ripple component of diode current goes through capacitor and its average goes through the load.
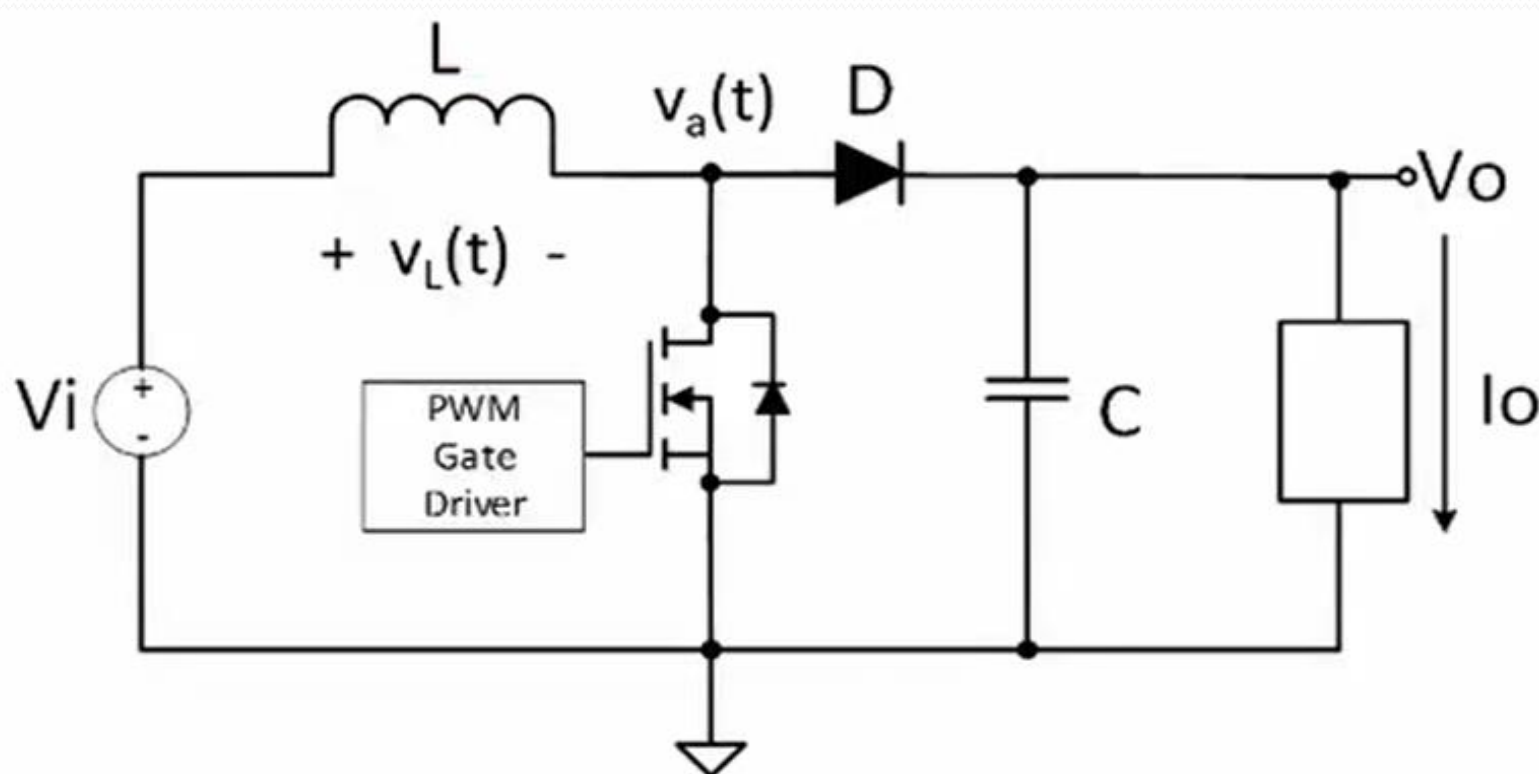

$$V_o = V_i \left(\frac{1}{1-D}\right) \qquad L = \frac{V_i D}{fs \times \triangle I}$$

$$I_i = I_o \left(\frac{1}{1-D}\right) \qquad C = \left(\frac{I_o \times D}{f_s \times \triangle V_o}\right)$$

The MPPT algorithm in the P&O technique depends on calculating the PV output power and monitoring changes in power by sampling the current and voltage of the PV Array. The tracker disturbs the duty cycle by regularly increasing or decreasing the voltage of the solar array. If a specific disturbance results in an increase in the output power of the photovoltaic (PV) system, then the following disturbance is produced in the corresponding direction. The duty cycle of the dc chopper is modified, and the operation is repeated until the maximum power point is obtained.
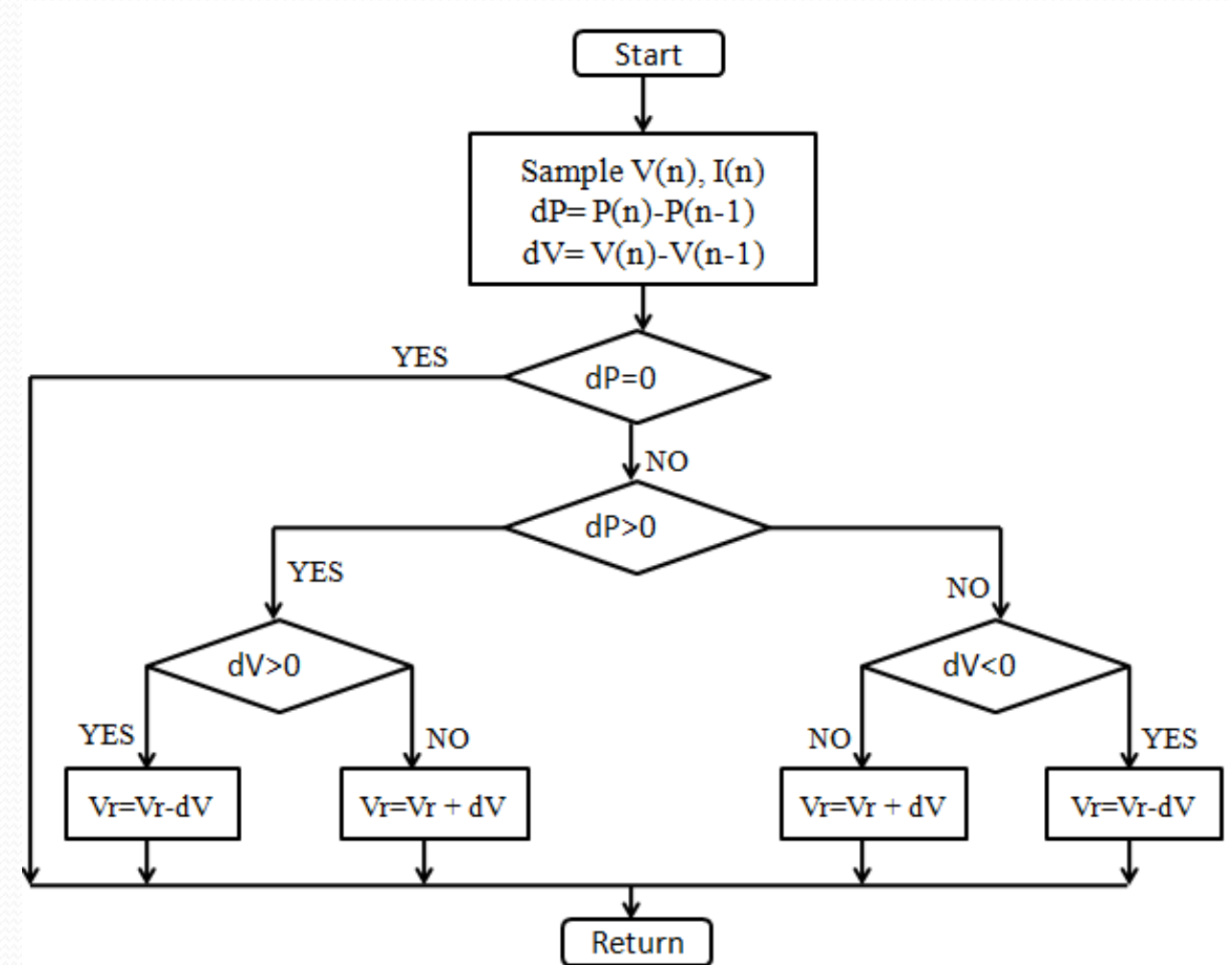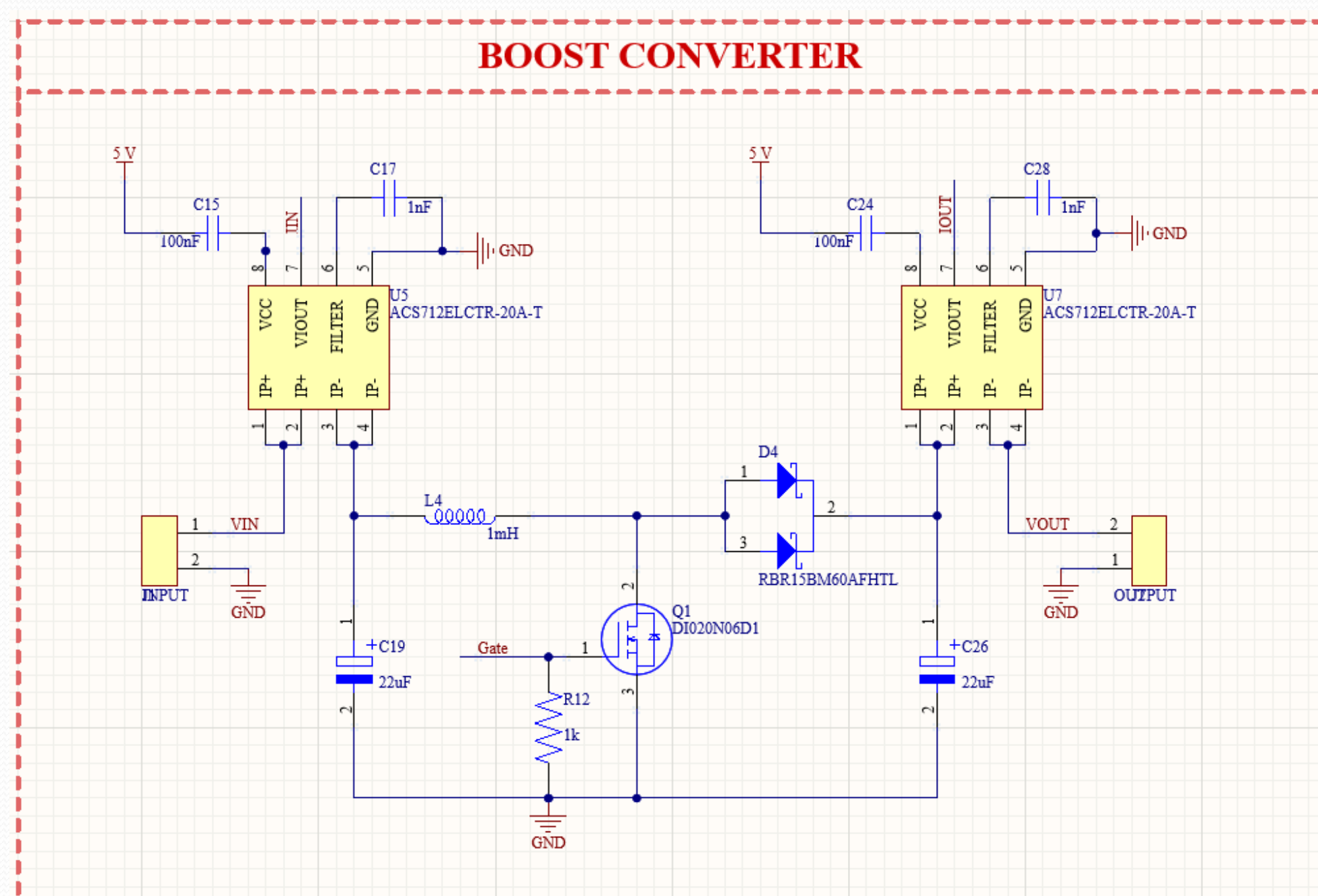

3 EXPERIMENT / SIMULATION
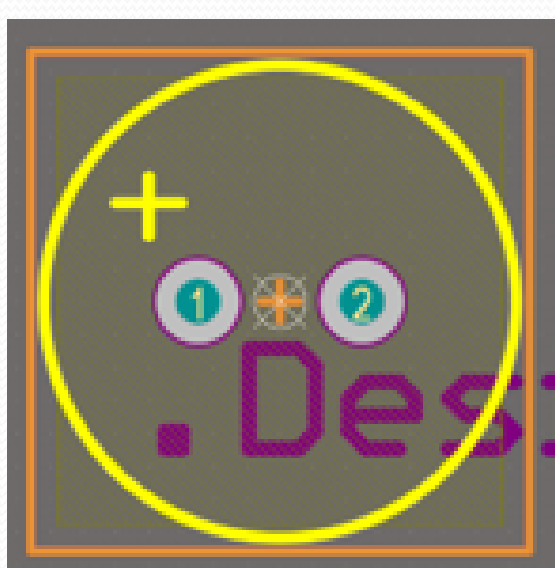
After calculations and component selection, the design was made. In order to make the design, schematic drawings and footprint drawings of the components were made and libraries were created.
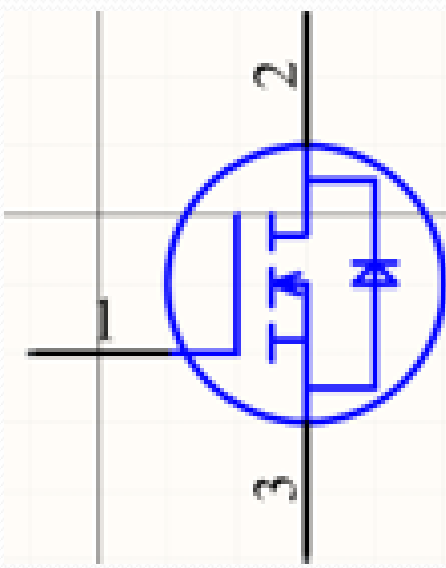
BOOST CONVERTER

The schematic design including boost converter, gate driver, voltage regulators and processor part is completed.


In the project, Perturb & Observe algorithm will be used for the operation of the MPPT board and STMCubeIDE will be used for STM microcontroller programming. Pins for ADC reading, PWM generation and test LED are set.
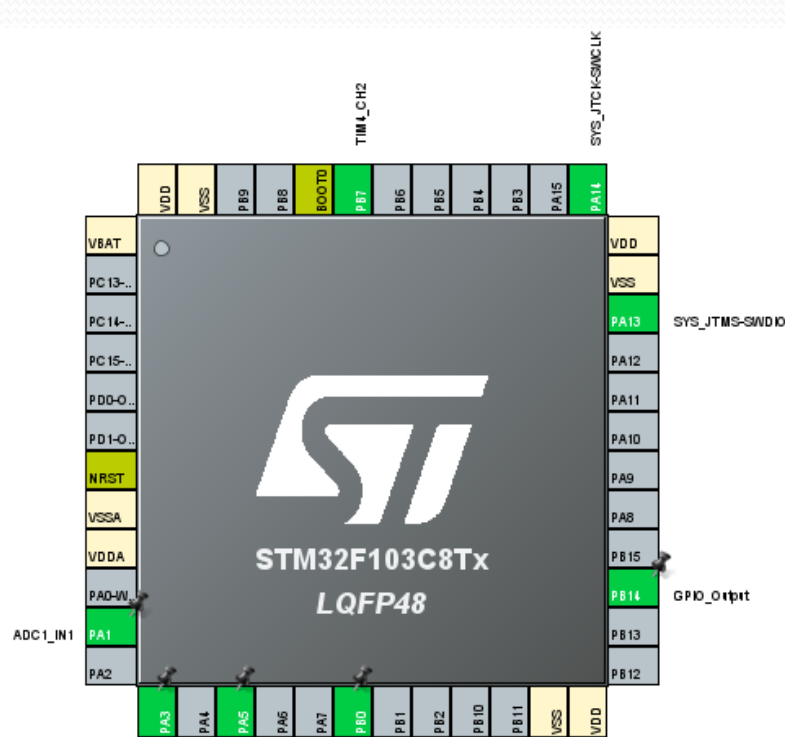
4 RESULTS

The output product of the pcb design, which was completed by utilizing the 3D image of the components, is as follows. The board was sent to printing and typeset. Thus, a concrete product has been put forward.
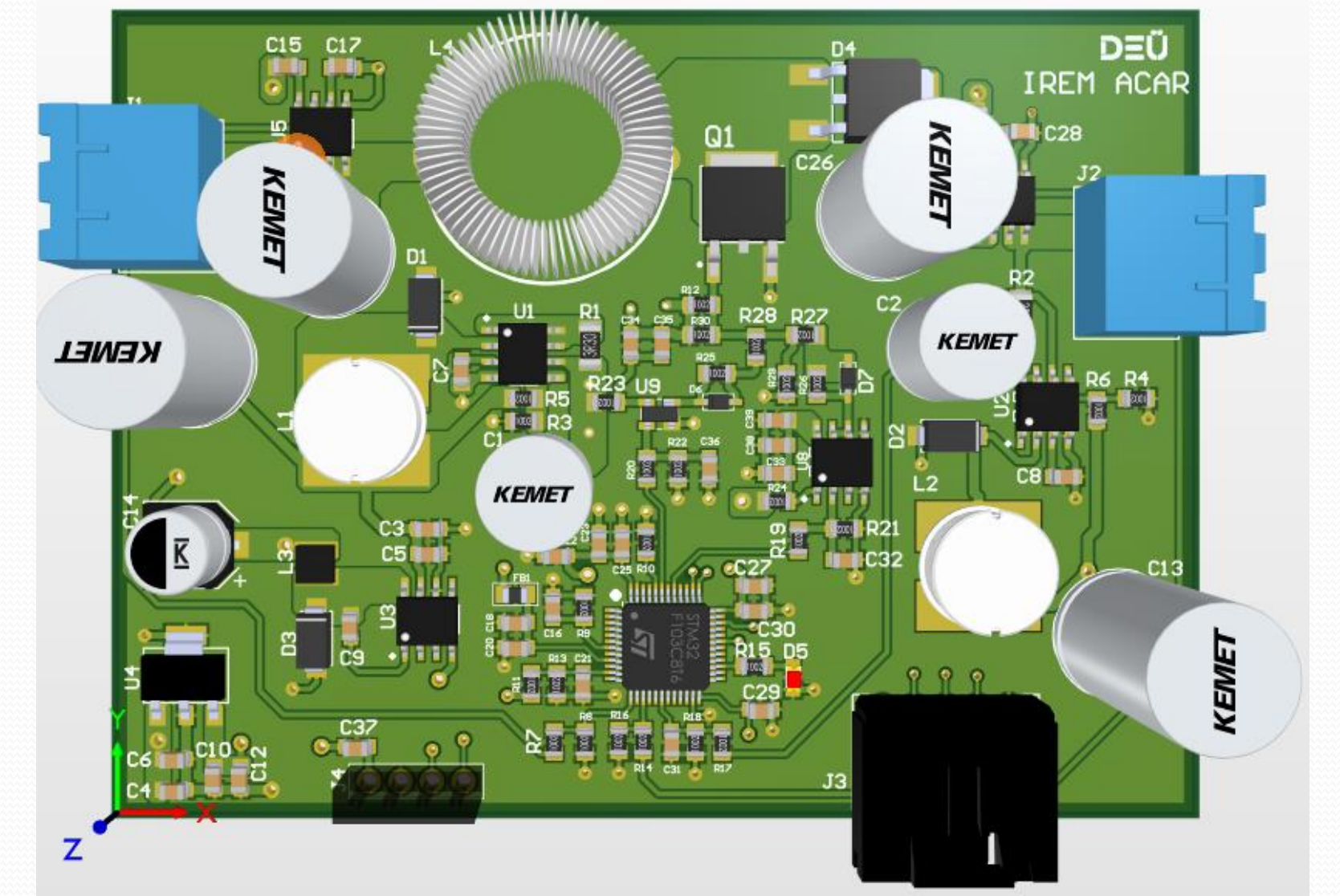
ADC reading, PWM generation and led output settings of the software were made. Basic perturb and observe part is given.

```c
362 void perturb_observe(uint32_t vin,uint32_t iin){
363
364
365     Power_in=vin*iin;
366     dV=vin-Vold;
367     dP=Power_in-Pold;
368
369     if(Vout_adc >= 37.8)
370     {
371         //if the output volt exceeds 37.8, the du
372         CH2_DC=CH2_DC-100;
373     }
374
375     //necessary calculations are being made for t
376     if(dP!=0){
377
378         if(dP < 0)
379         {
380             if(dV < 0){
381                 CH2_DC = dutyold - delta;
382                 HAL_Delay(1);
383
384             }
385             else{
386                 CH2_DC = dutyold + delta;
387                 HAL_Delay(1);
388
389             }
390         }

391         else{
392             if(dV <= 0){
393                 CH2_DC = dutyold + delta;
394                 HAL_Delay(1);
395
396             }
397             else{
398                 CH2_DC = dutyold - delta;
399                 HAL_Delay(1);
400
401             }
402         }
403     }
404
405     else{
406
407         CH2_DC = dutyold;
408     }
409
410     //new duty is being used in the
411     TIM4->CCR2 = CH2_DC;
412
413     HAL_Delay(1);
414     dutyold = CH2_DC;
415     Vold = vin;
416     Pold = Power_in;
417
418 }
419
420 /* USER CODE END 4 */
```

5 COST ANALYSIS

• The project, which was planned to cost less than 100 dollars, was completed for a total of 42.82 dollars. In this way, the accessibility of the design has increased if it is presented as a product.

• Nowadays, when solar panels are becoming more and more widespread, it was very valuable to learn the design parameters of an MPPT design and to realize the design. As a result of the increase in MPPT design and ease of accessibility, it will also provide ease of use to solar energy in the long run.

6 CONCLUSION

In this study, we set out to realize MPPT design and many successes have been achieved in this process. Through the studies, the properties of solar panels, DC-DC converter types and MPPT algorithms have been researched and learned through calculations.

The process of transforming an idea into a product was followed step by step and a concrete product with its design and software was put forward.

7 REFERENCES

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