

Automatic weld path detection and G-code generation for welding

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Introduction

In this project, main focus is on automating the welding process with computer vision. A camera is acting as a visual sensor in the system and it will capture the image of work piece and detect the joints to be weld and the system automatically mark the joints and generate the motion code (G-code) for the movement of the weld torch in a 3 axis coordinates CNC machine. The system can calibrate and it can transfer the image coordinates into real coordinates. A graphical user interface is also developed for any unskilled user. For the proof of concept, a prototype of a 3axis CNC machine is fabricated in low cost and tested the automated system on it. Full algorithm of the control system and program are explained in this project. The fabrication process of prototype of the CNC machine and testing are also explained.

Objectives and Methodology

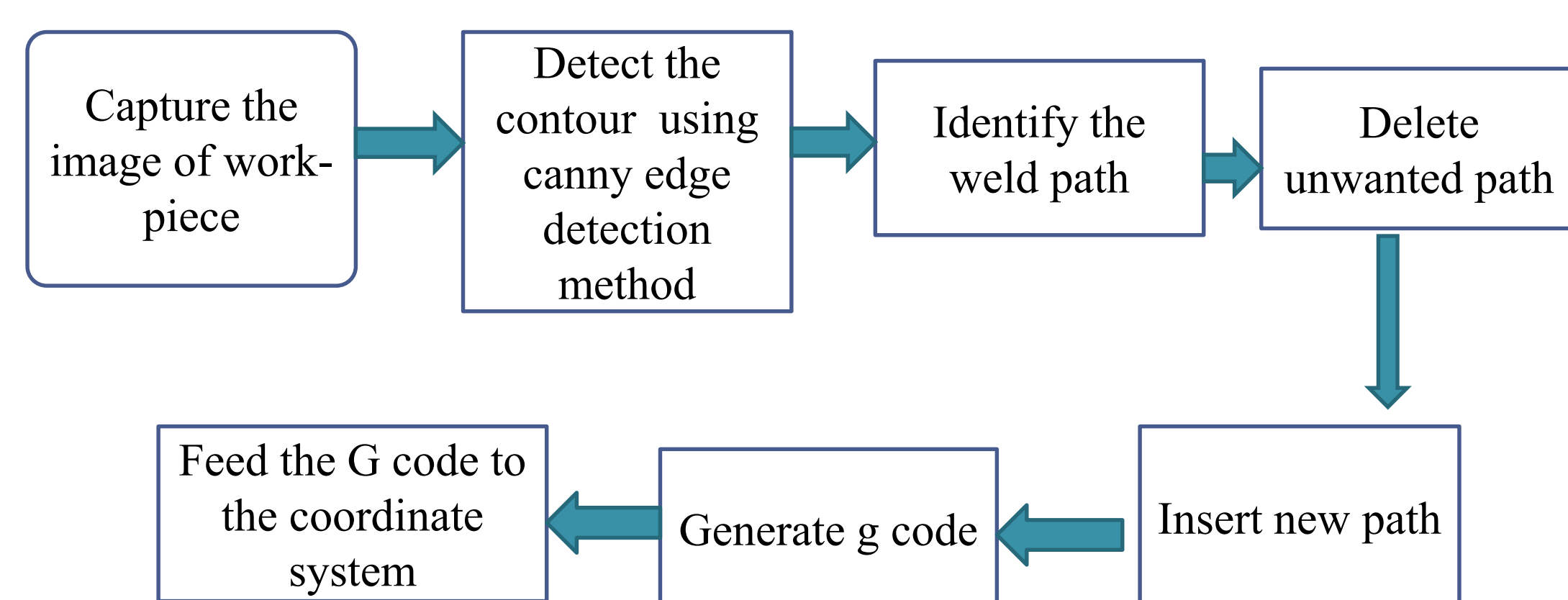
Objective

- To develop a program to detect the weld path and generate the G-code.
- To prove the concept, fabricate a prototype of 3 axis CNC
- To identify the best algorithm for edge detection.
- To design the prototype of 3 axis system.
- To fabricate designed prototype system.
- To calibrate and test the prototype.

Methodology

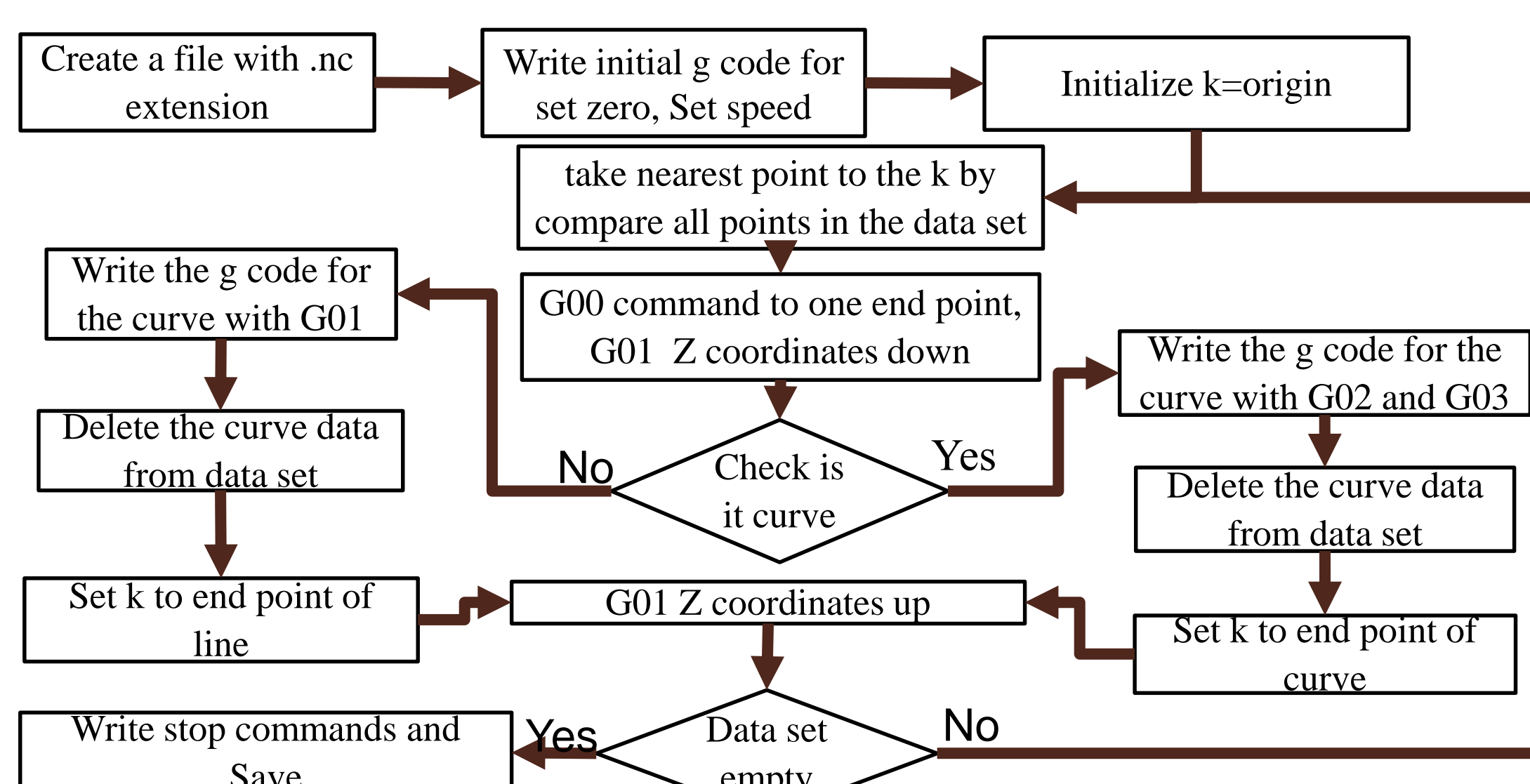
- Literature survey
- Development of the algorithm
- Development of the program for contour detection
- Testing of the program
- CAD model design of prototype in Solid Works
- Fabricate a miniature version of 3 axis CNC machine
- Calibration of the system
- Testing in real time

Algorithm



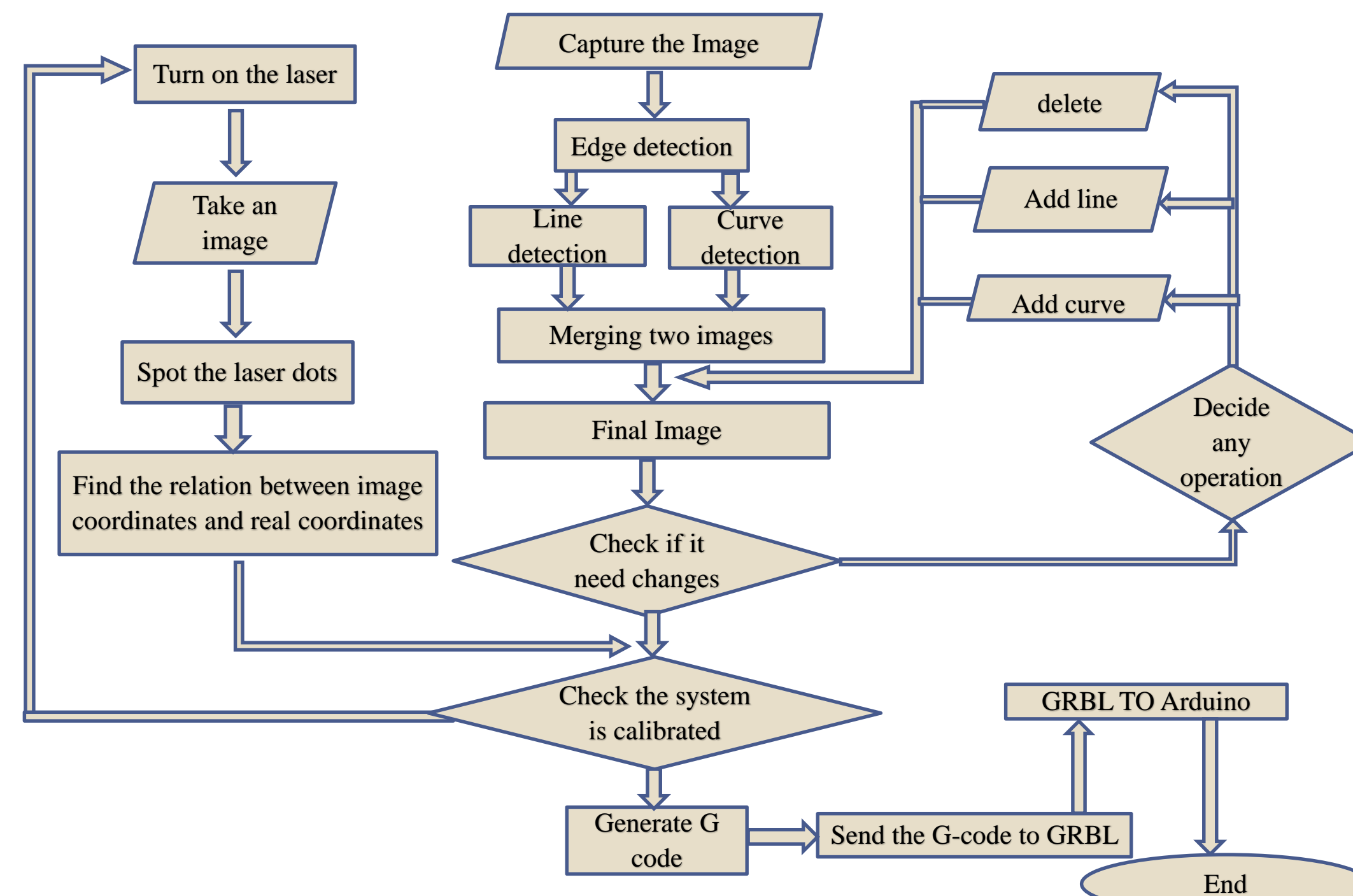
This flow chart explain the brief algorithm of developed program

G code generation algorithm

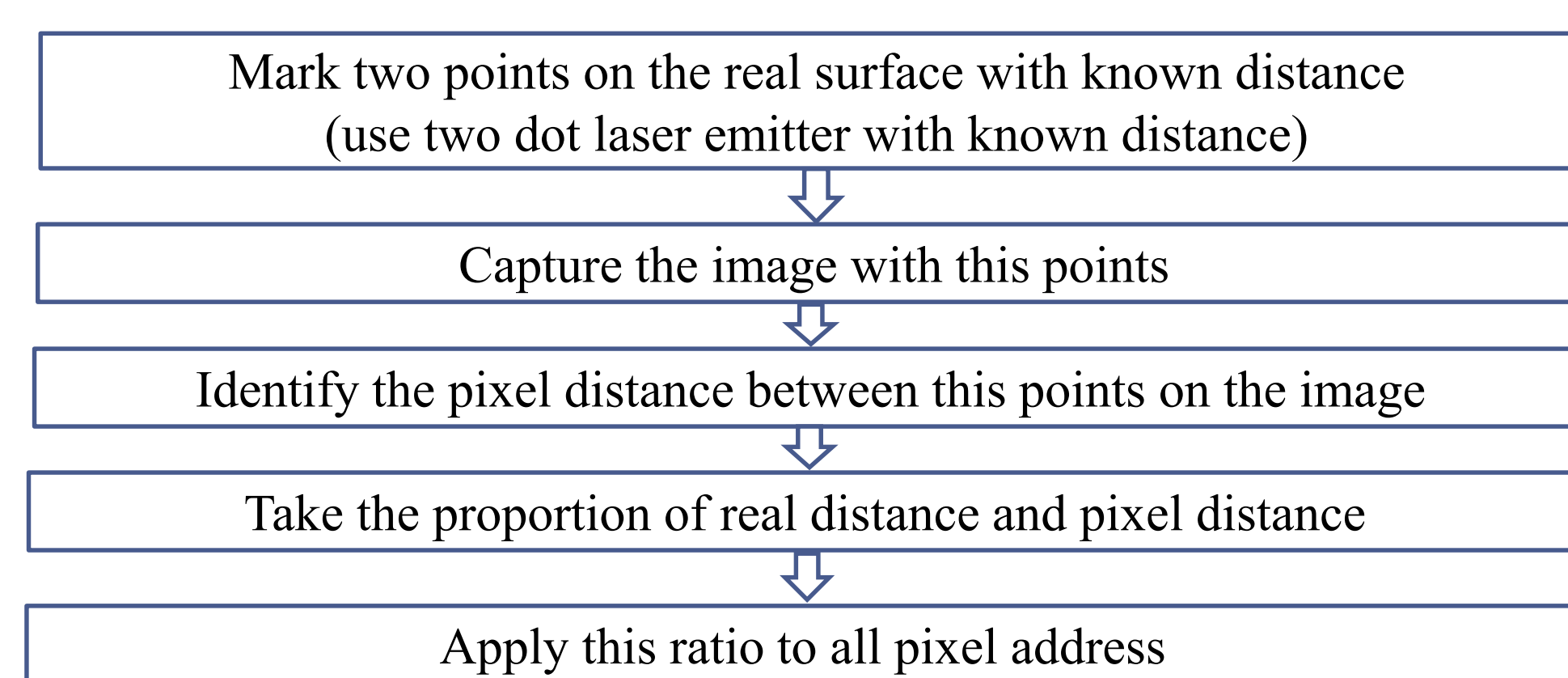


This flow chart explain the algorithm for G code generation from the data obtained from image processing

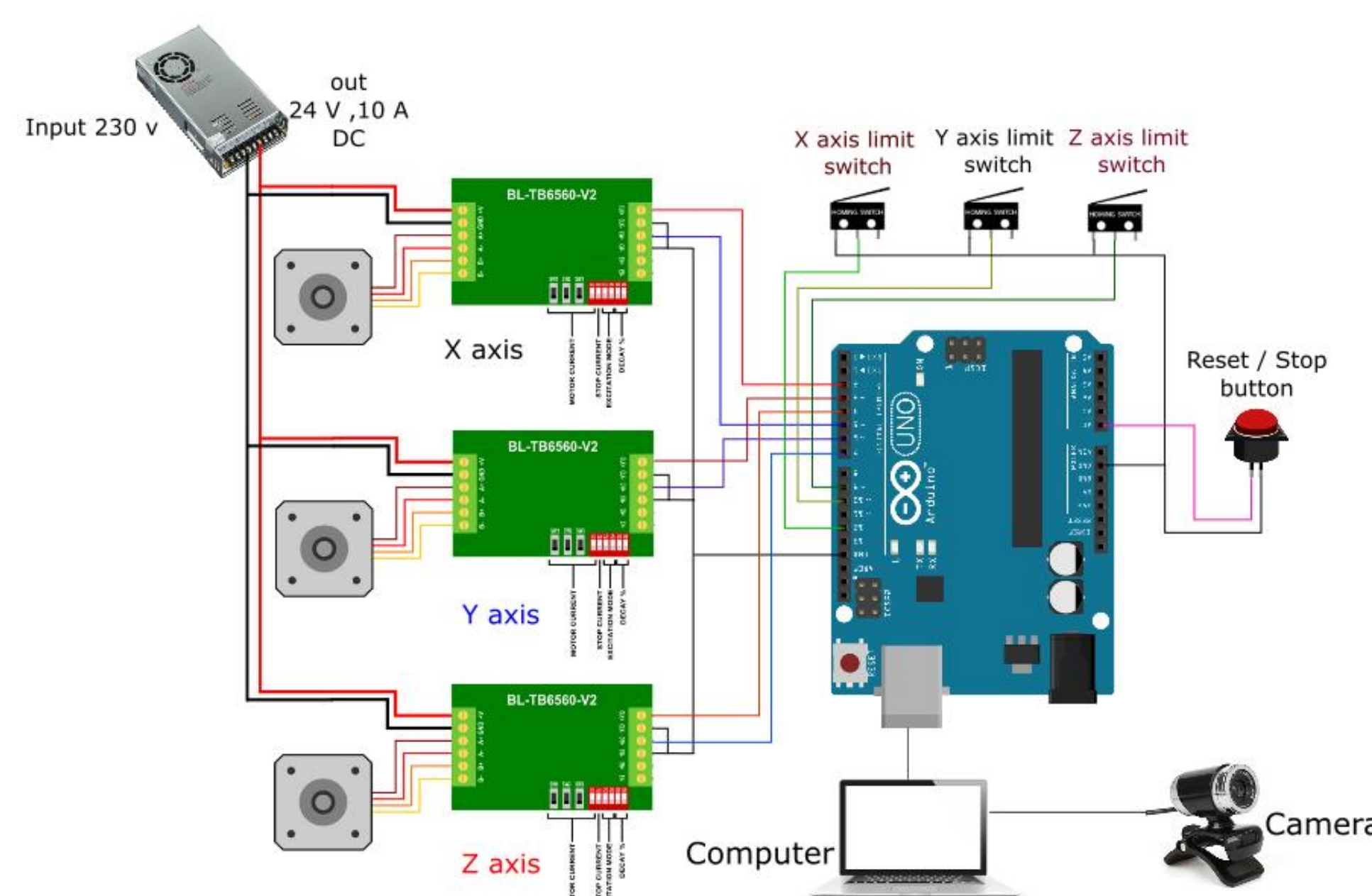
Complete detailed Algorithm



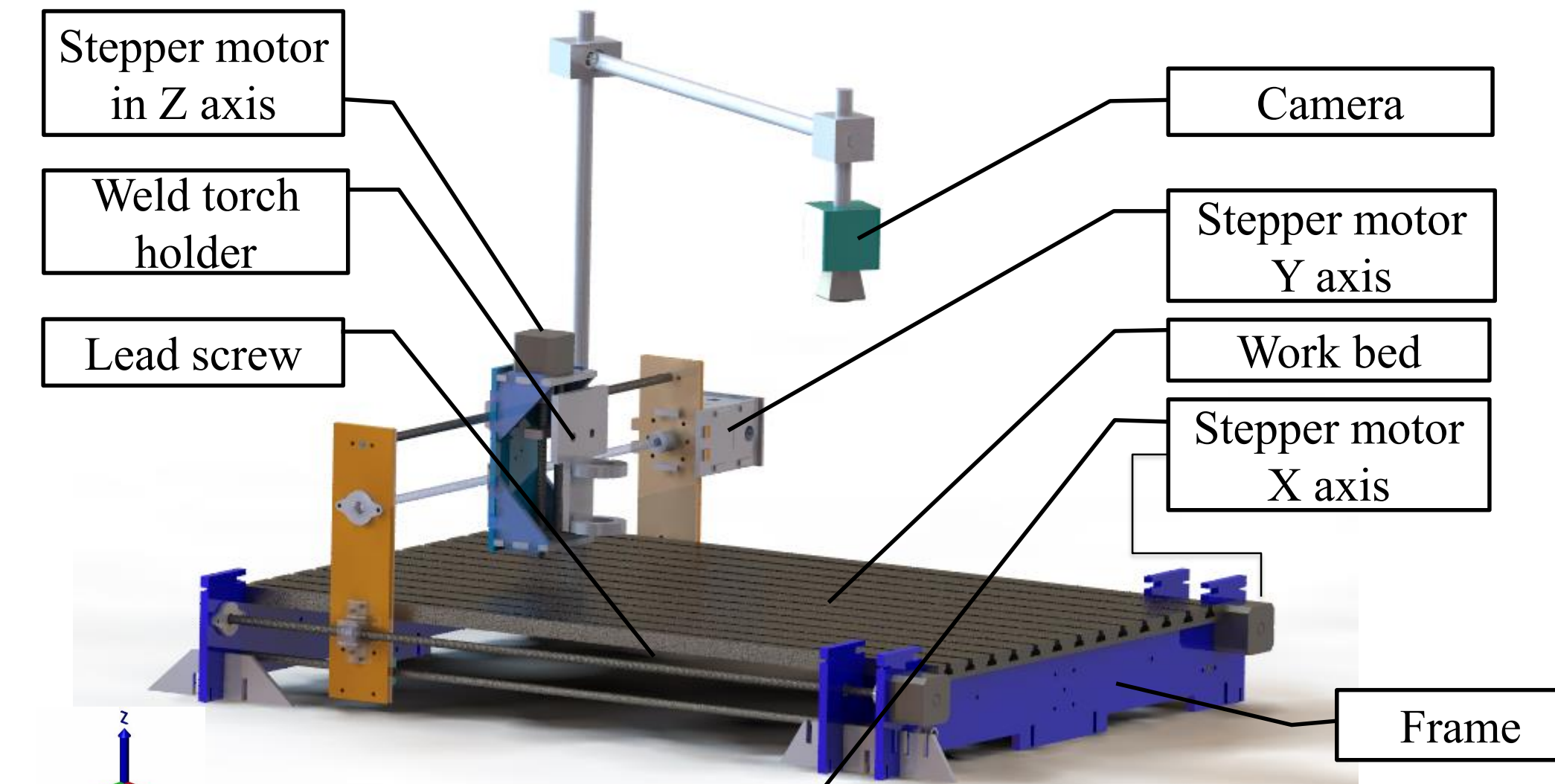
Calibration Algorithm



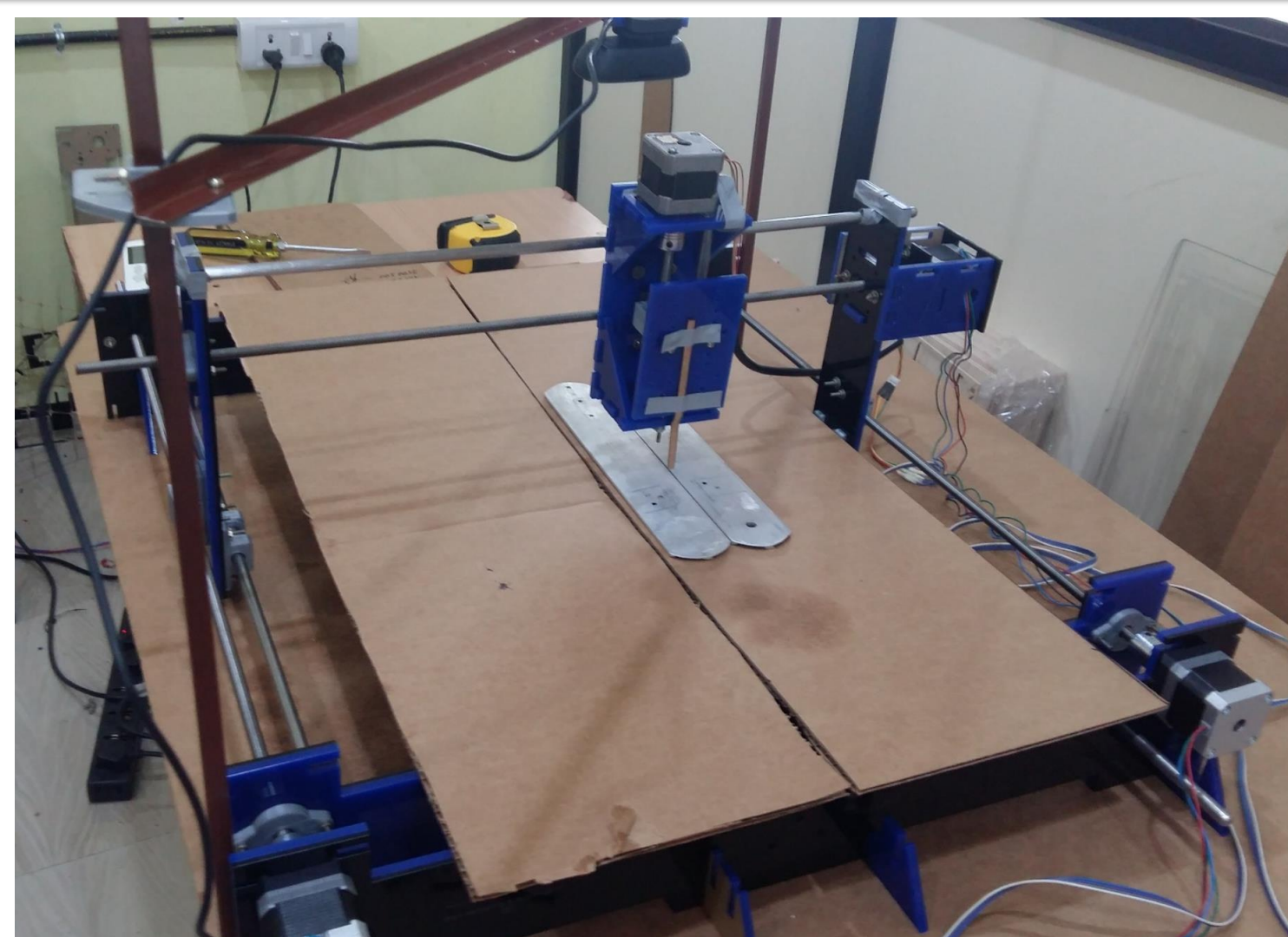
Electrical Circuit



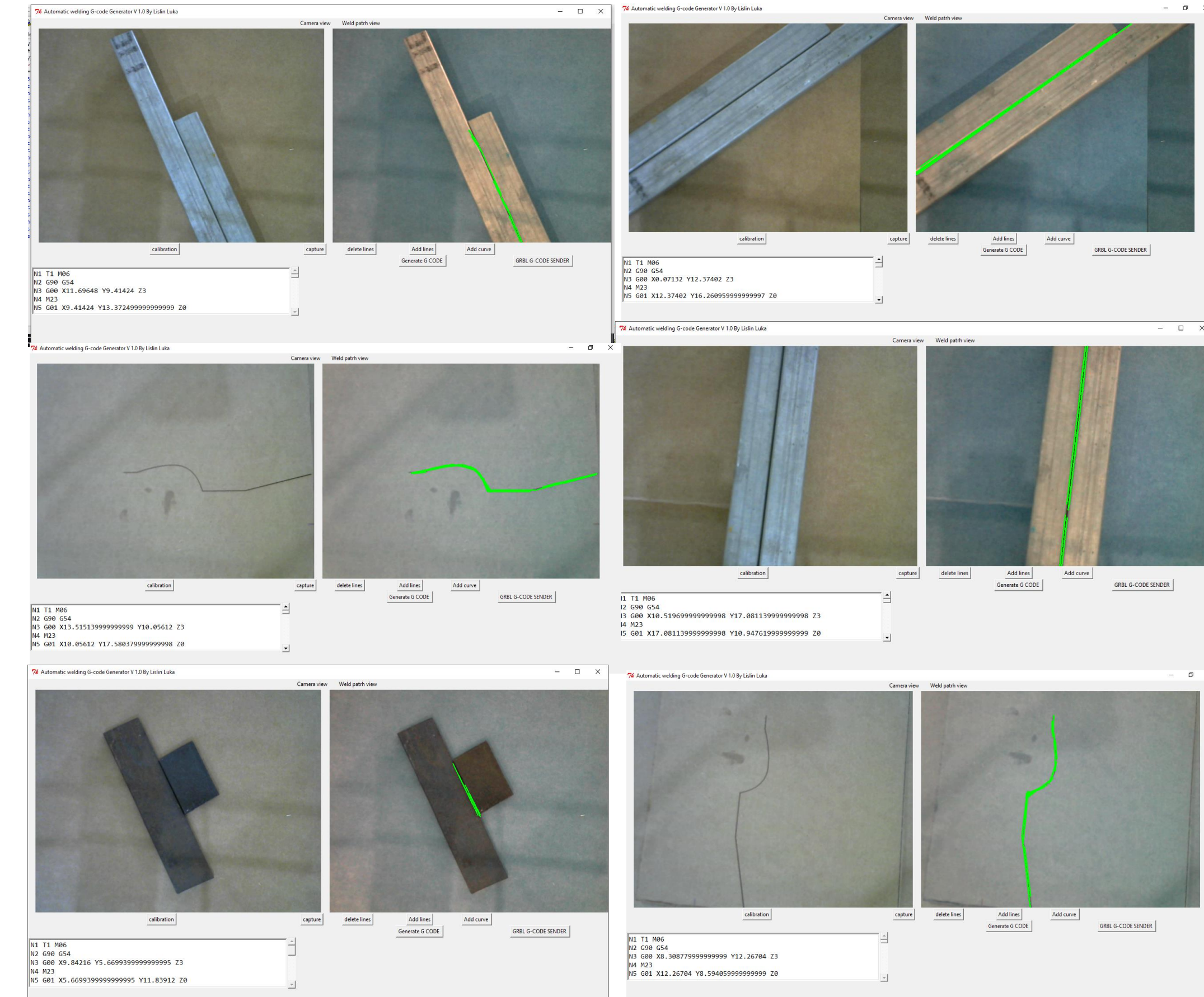
CAD model of system



Prototype



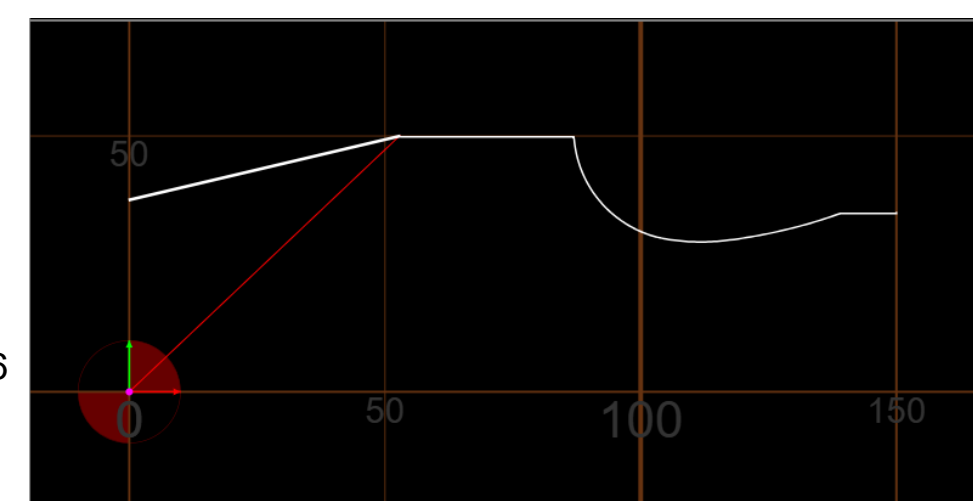
Results



- Above figures show the screen shot of developed GUI for the weld seam detection and G-code generation
- In different orientation the system successfully find the weld path and generate G-code
- Generated weld path verify in a G-code simulator
- The generated G-code and simulation result are shown below

```
G00 Z5.000000
G00 X52.983365 Y50.14374
G01 Z-1.000000 F100.0(Penetrates)
G01 X-0.003307 Y37.639981 Z-1.000000 F400.000000
G01 X0.062839 Y37.360516 Z-1.000000
G01 X53.016989 Y49.856566 Z-1.000000
G01 X86.891924 Y49.856566 Z-1.000000
G02 X87.019383 Y49.044176 Z-1.000000 I-7.403867 J-1.577811
G03 X104.976194 Y29.858477 Z-1.000000 I21.568975 J2.192199
G03 X116.533296 Y29.565304 Z-1.000000 I6.803391 J40.253367
G03 X127.399633 Y31.453142 Z-1.000000 I-11.616101 J99.078953
G03 X138.951114 Y34.830004 Z-1.000000 I-23.770492 J102.759426
G03 X139.023108 Y34.856344 Z-1.000000 I-1.386780 J3.901871
G01 X150.000008 Y34.856344 Z-1.000000
G01 X150.000008 Y35.143528 Z-1.000000
```

G code simulation



Conclusions

- Developed a program for automatic detection of weld path and generation of G-code.
- With the developed graphical user interface, user can easily operate the system.
- Using this system weld tool path generated automatically.
- Error due to misplaced work-piece can be avoided.
- In complicated weld path, G code is generated easily.
- Using the fabricated prototype, the developed system is tested successfully.

Future Directions

- Develop a solution for generate G code in three dimensional welding.
- Incorporate the developed system with robotic arm.
- Including artificial intelligent to track the weld path more accurately.

Acknowledgments

I would like to express my deep gratitude to my Guide, project coordinates, and all other faculty members, especially for their suggestions, support and encouragement. I also thank my parents and friends for their invaluable support without which this would have been a greater task for me to complete

I would also like to express my deep gratitude FAB lab CET for technical support in fabrication and kind of cooperation for making my project a success

Literature Cited

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