The research about introducing the closed-loop control and blackout continuing printing functions into 3D printers

Presented by:

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Project Background

- Base on the open-loop controlled 3D Printers.
- Introduce the closed-loop controlled system into them by adding the position feedback system whose main part is encoder.
- Introduce the blackout continuing printing system based on previous data.
- Thus enhance the accuracy and stability of 3D Printers.

Why Closed-Loop Control?

- When encounter high intensification in process, the step out of step motors emerges.
- The accumulation of stepping out will result in disorders of layers.

Analysis In Market

- Quasi-Industrial 3D prints

Closed-Loop Control

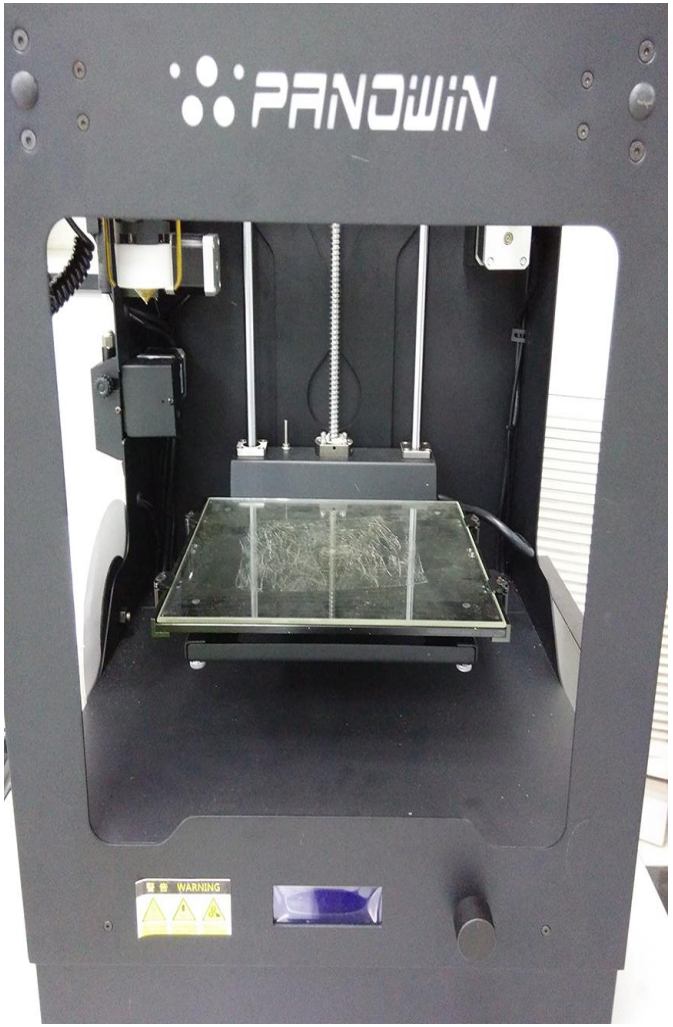
Expensive

- Ordinary 3D printers

Open-Loop Control

Affordable

Low-Precision

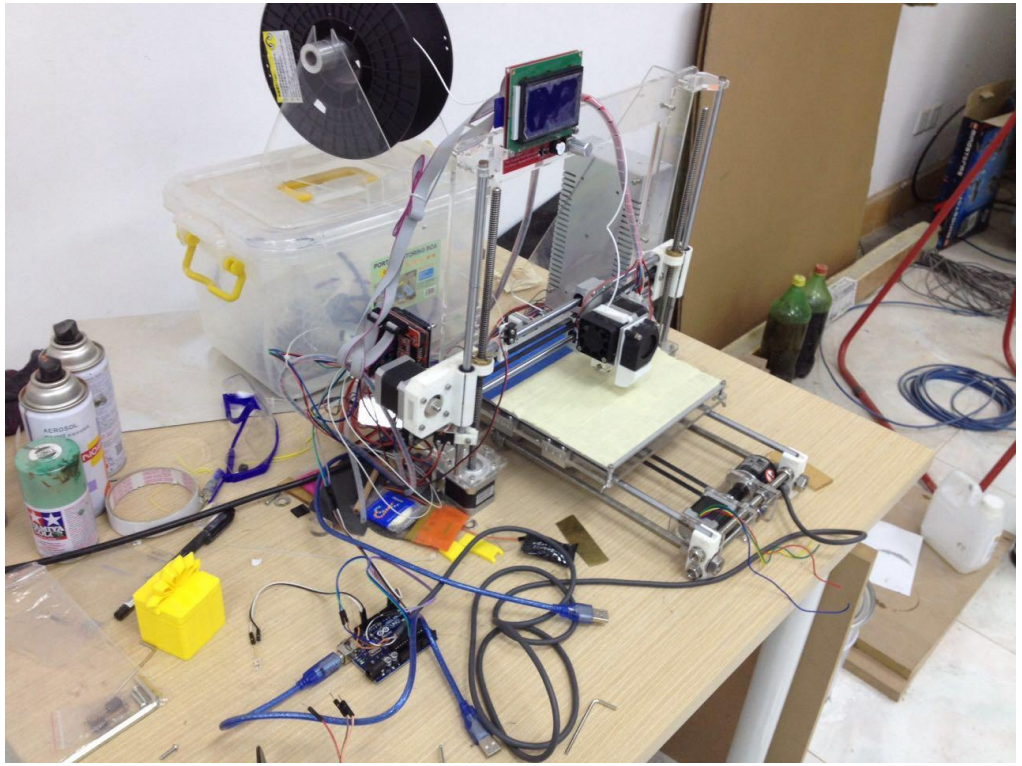


Introducing the Research

- 1. Selection of the type of 3D printers
- 2. Selection of the type of Encoders
- 3. Realization of data transfer
- 4. Realization of close-loop control
- 5. Selection of the module of blackout continuing printing function.
- 6. Blackout continuing printing realization

Selection of the type of 3D printers

- We use Mendel I3 type 3D printer. Since it's 3-axis translational structure is the most common one among the 3D printers in sale.Thus, it's a representative one.

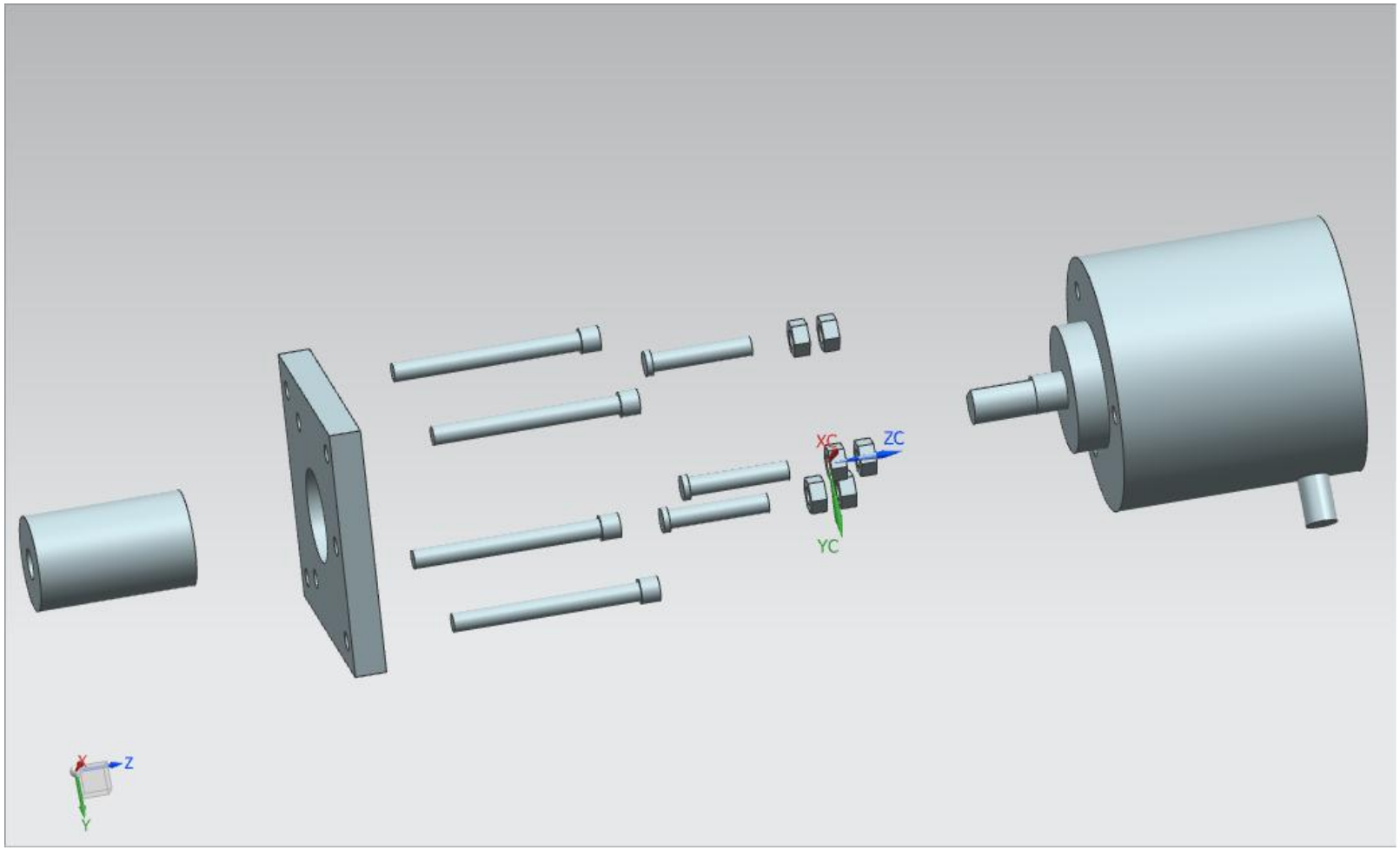


Selection of the type of Encoders

	Additive Type	Absolute Type
Price(in RMB)	200	Above 1000
Advantage	Affordable Easy to Manipulate Low Environment-Affection	Easily Conditioning More Precise
Disadvantage	Difficultly Conditioning Less Precise	Expensive High Environment-Affection

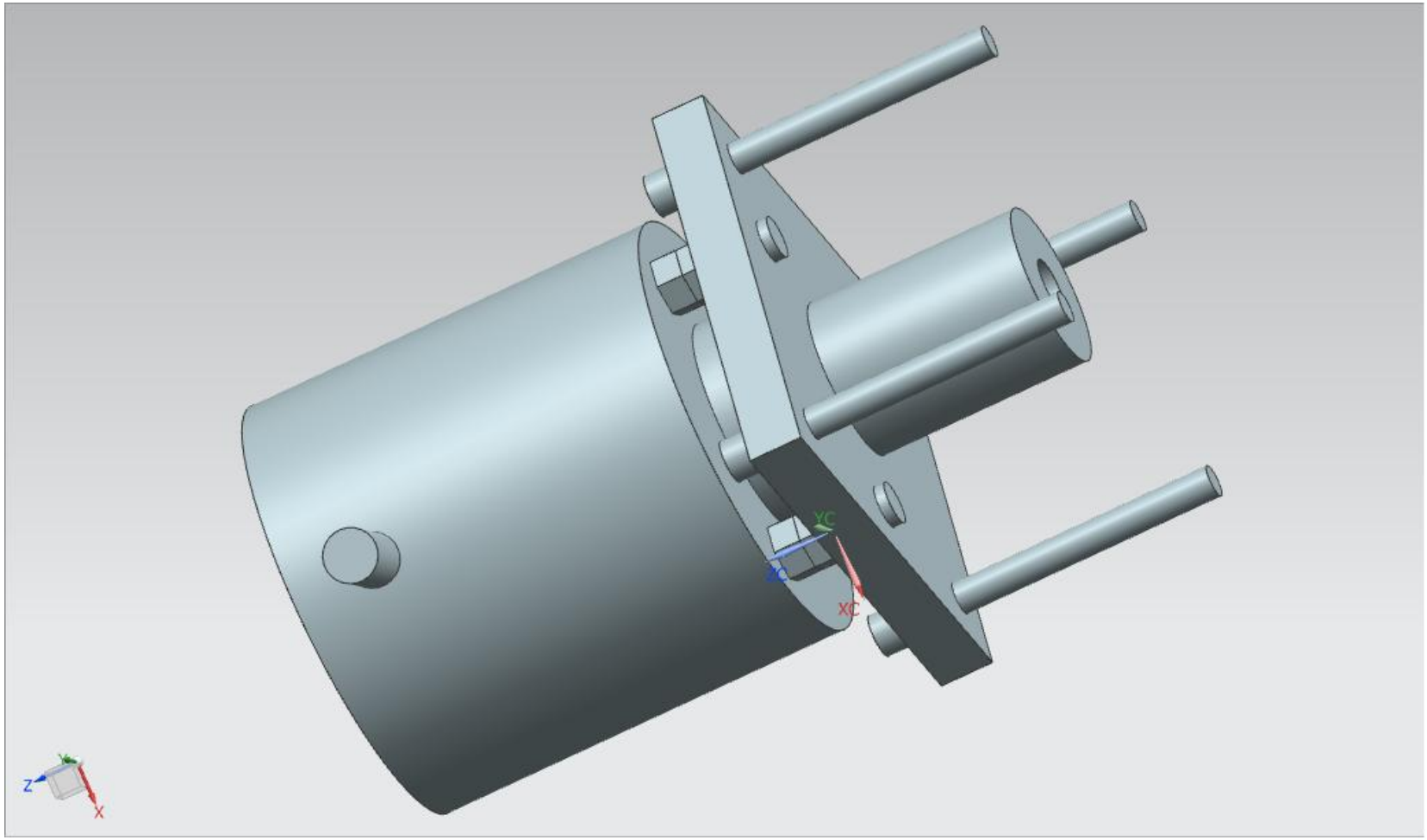
Conclusion: The resolution of x and y axis can reach to 3200, however, the 2000-resolution encoders can recognize the 4000-resolution displacement. Considering about the price and the environment, we will use 2000-resolution encoders

Mechanical Assembly



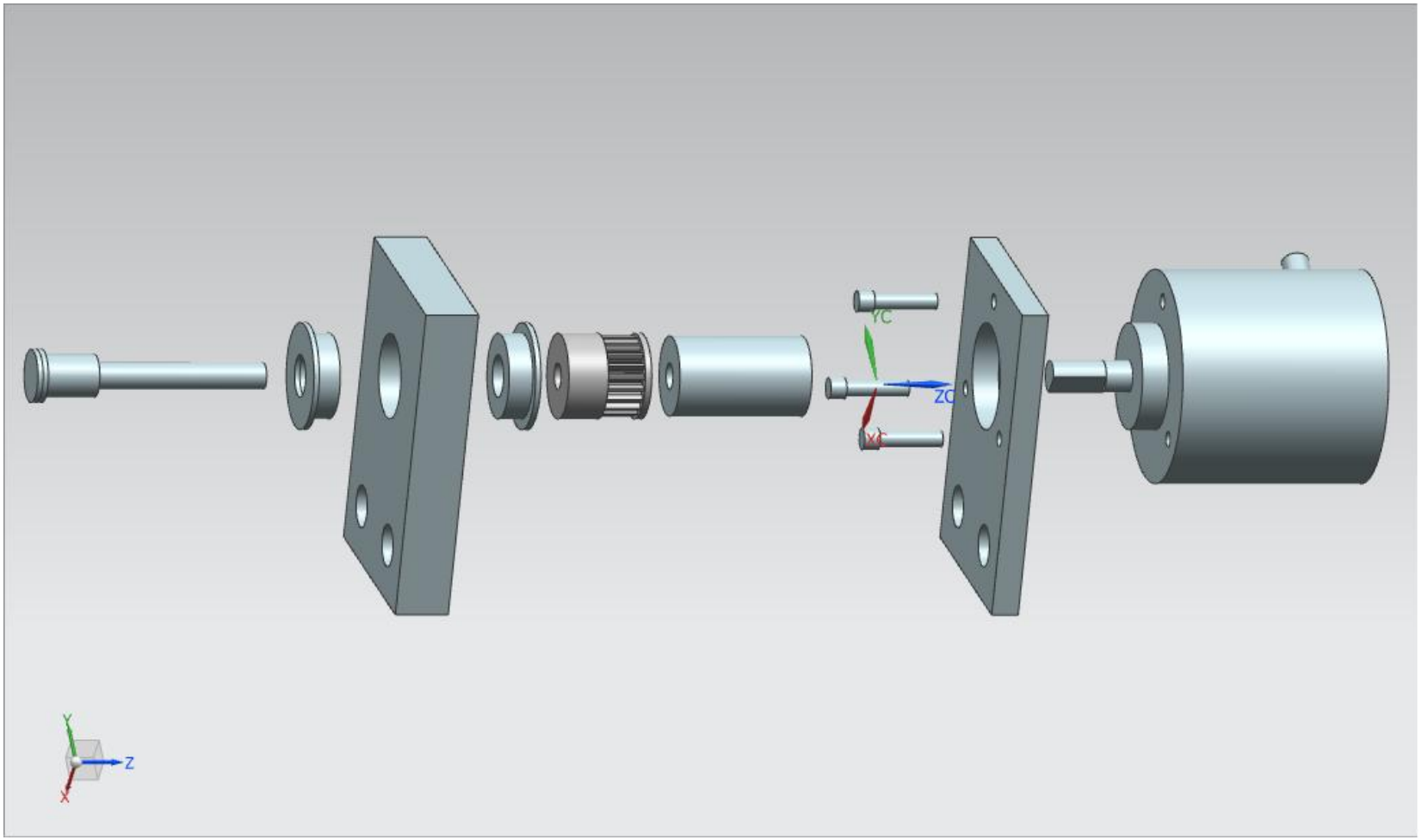
Explosive View of X Module

Mechanical Assembly



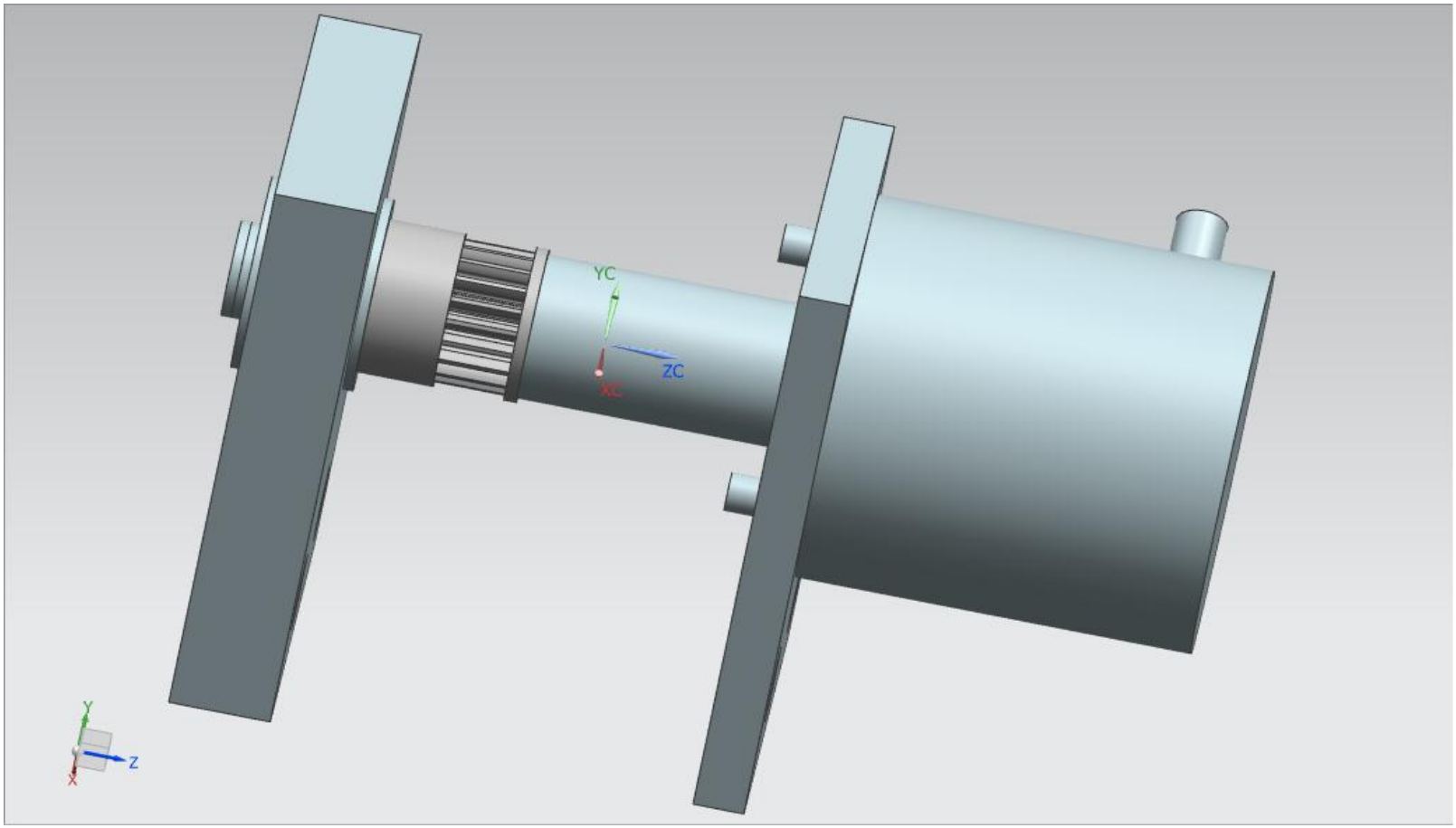
Assembly View of Y Module

Mechanical Assembly



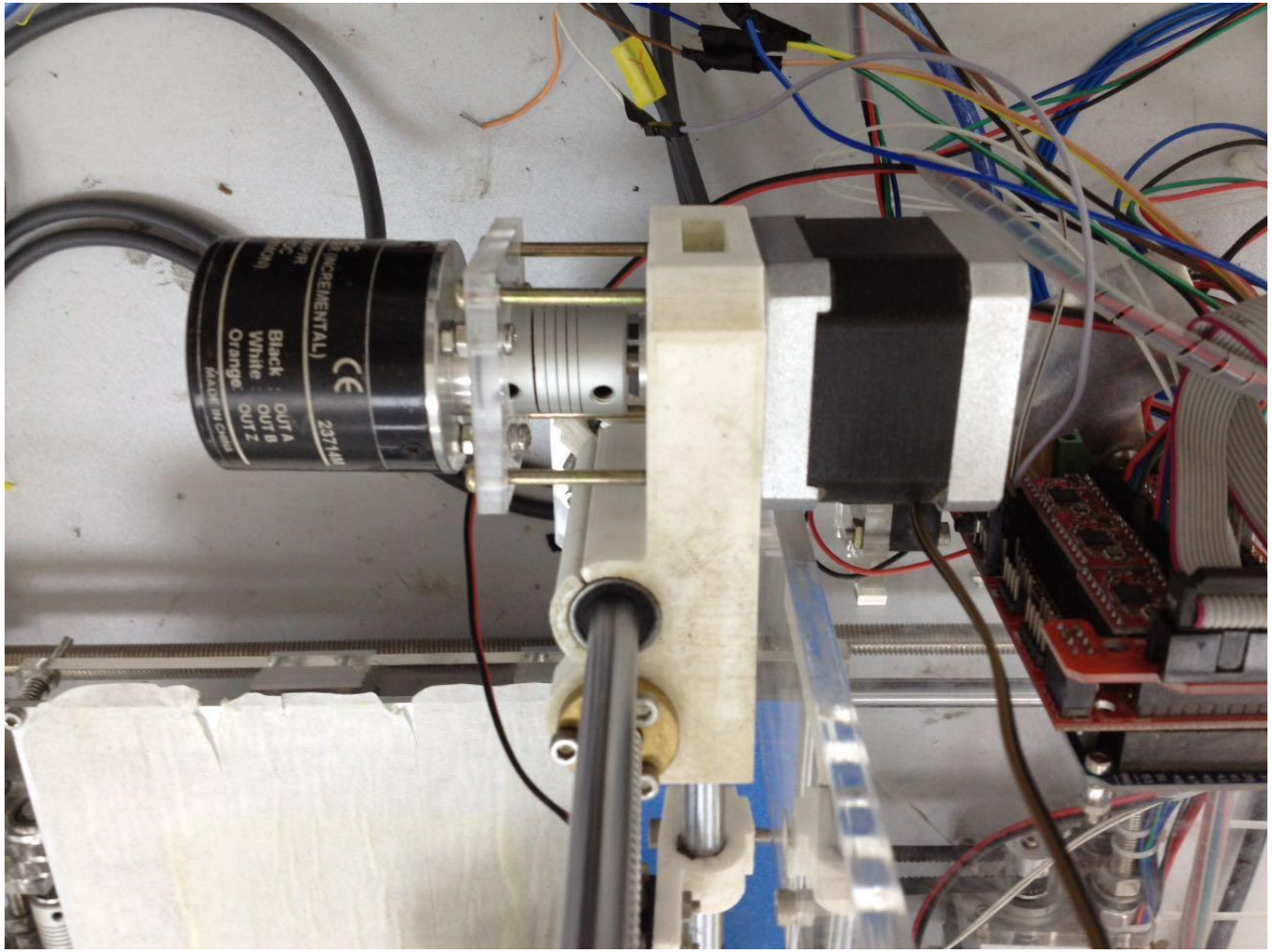
Explosive View of Y Module

Mechanical Assembly



Assembly View of Y Module

Mechanical Assembly

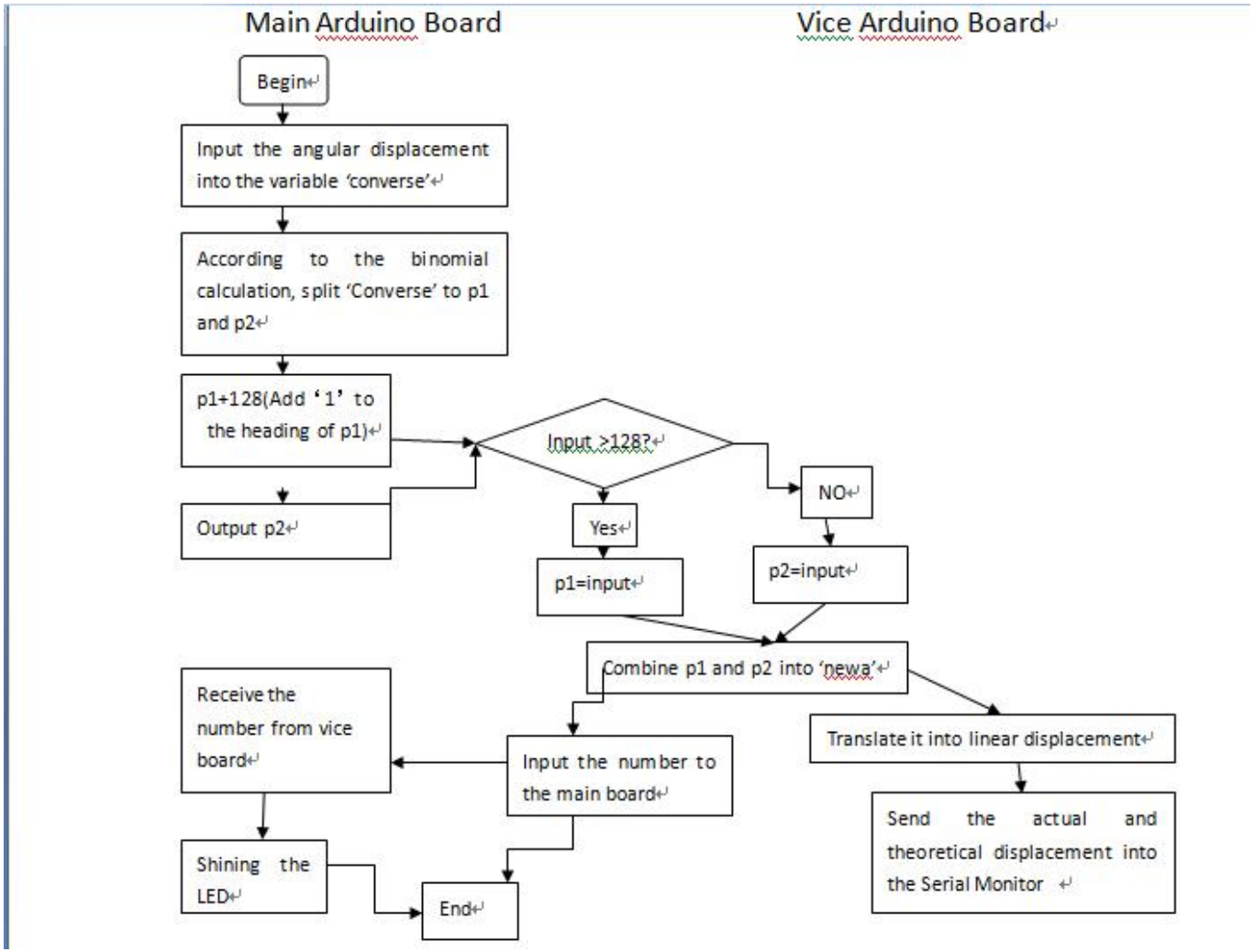


Exact View of X Module

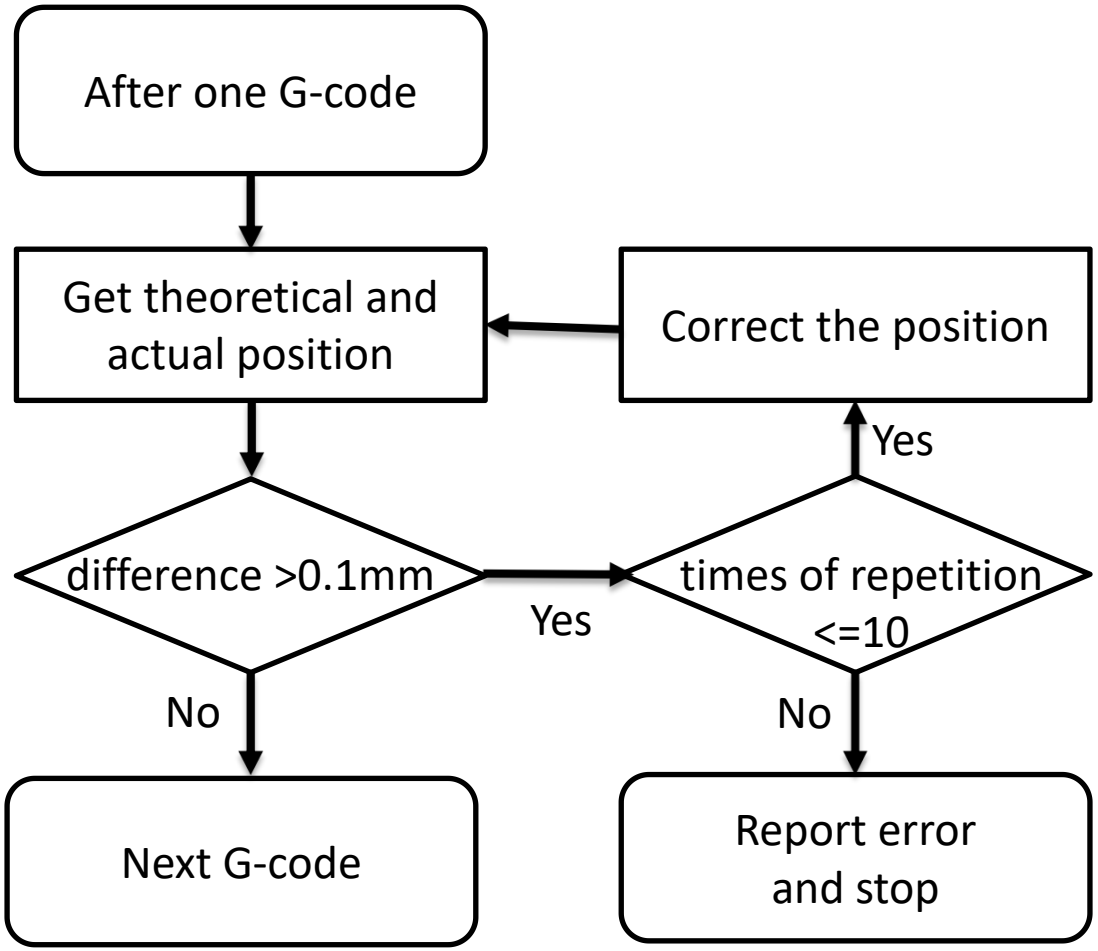
Mechanical Assembly

Exact View of Y Module

Realization of data transfer



Realization of close-loop control



Realization of close-loop control

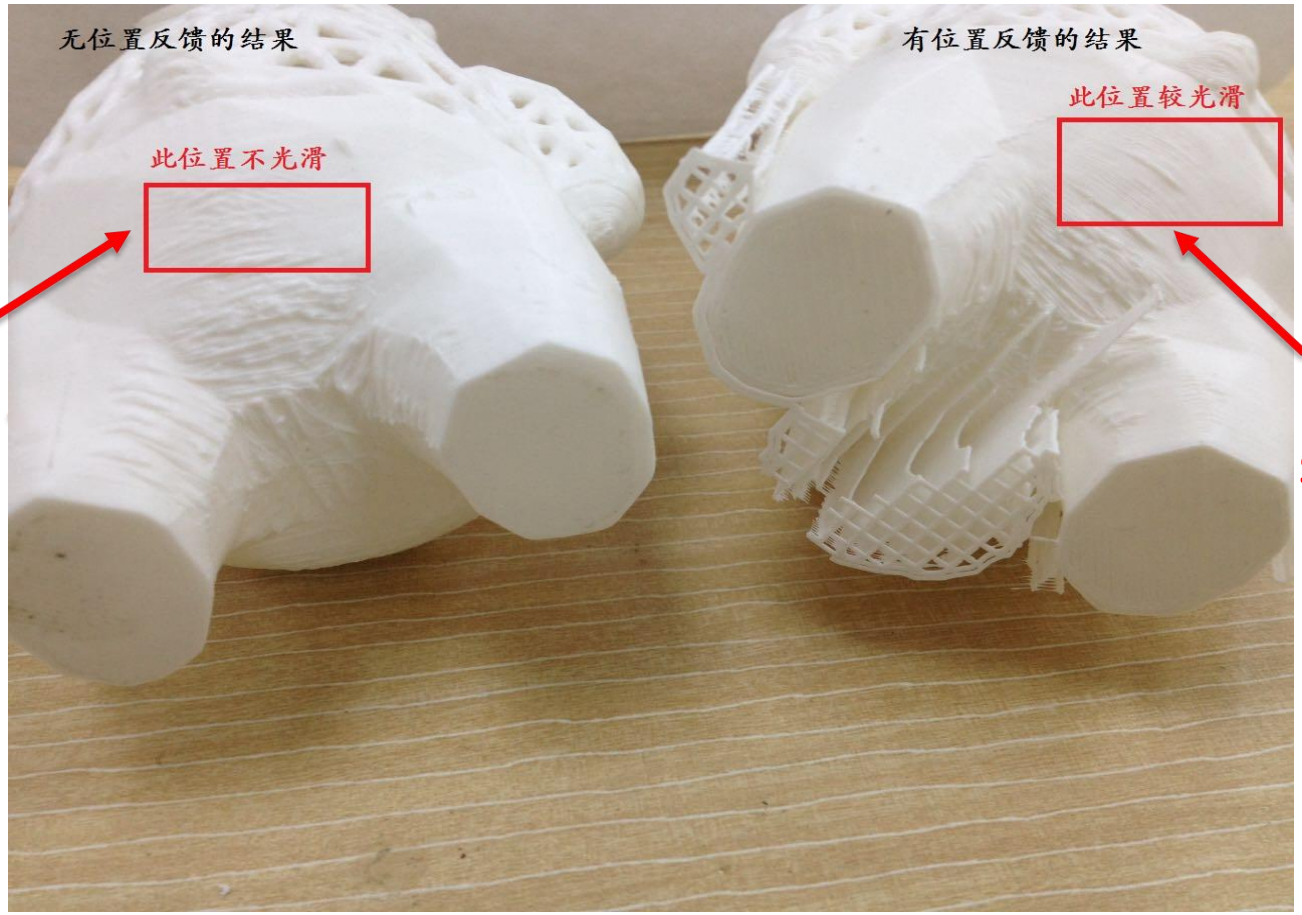
Without position feedback With position feedback

Something broken

Nothing broken

Realization of close-loop control

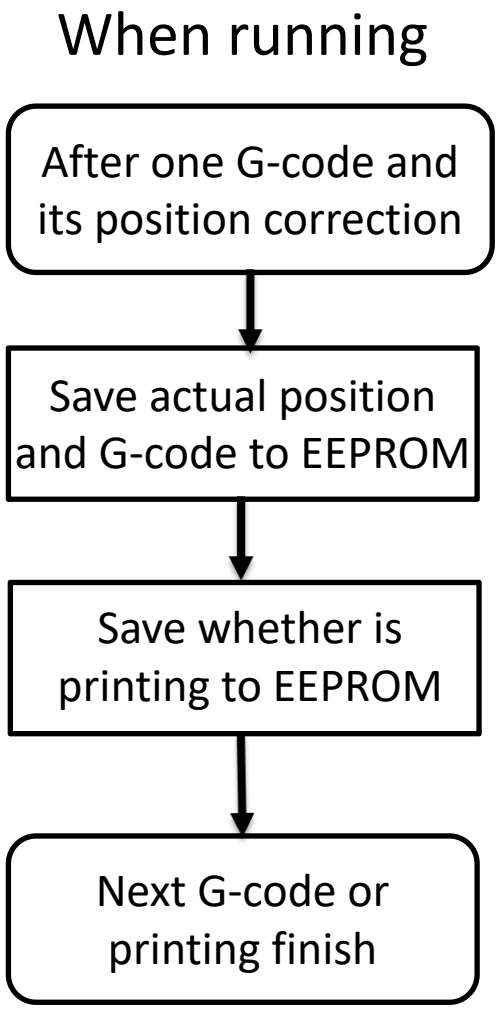
Without position feedback With position feedback

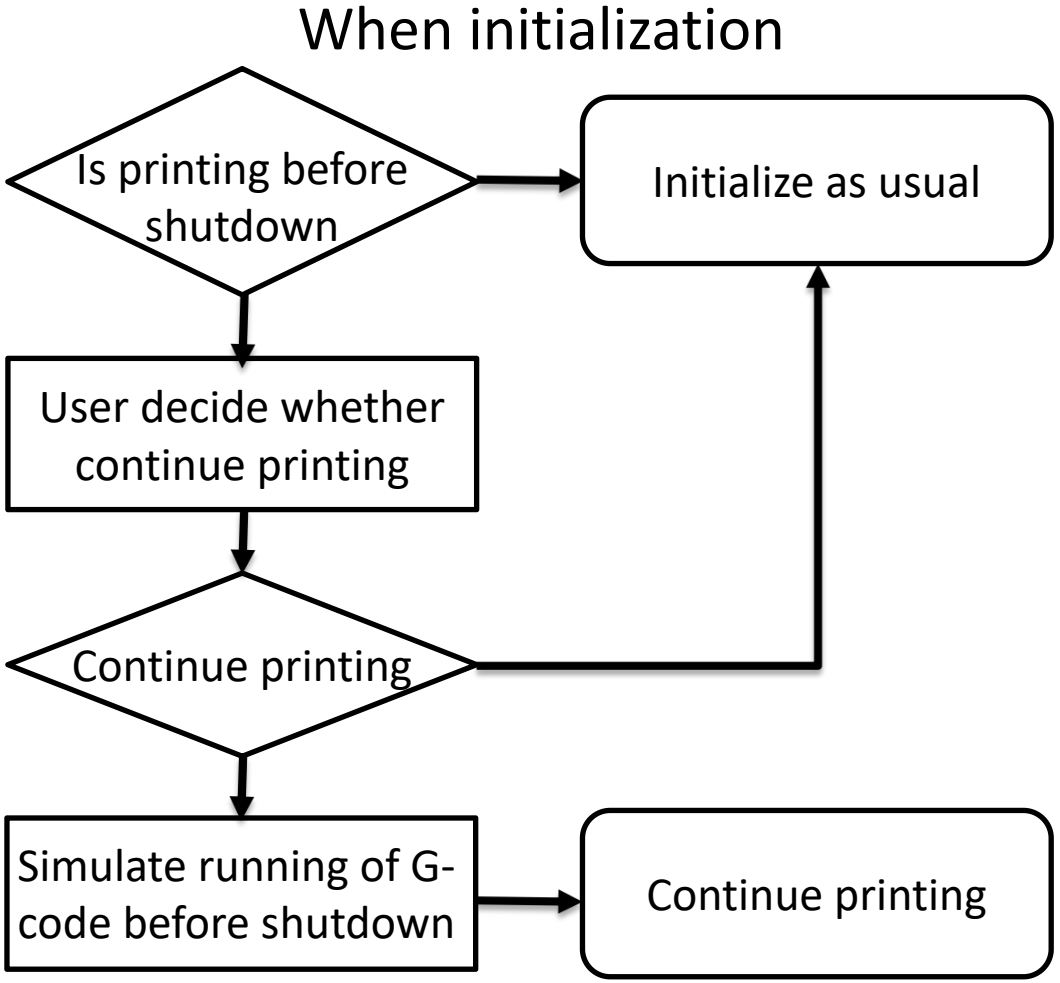


Rough

More smooth

Blackout Continuing Printing Realization

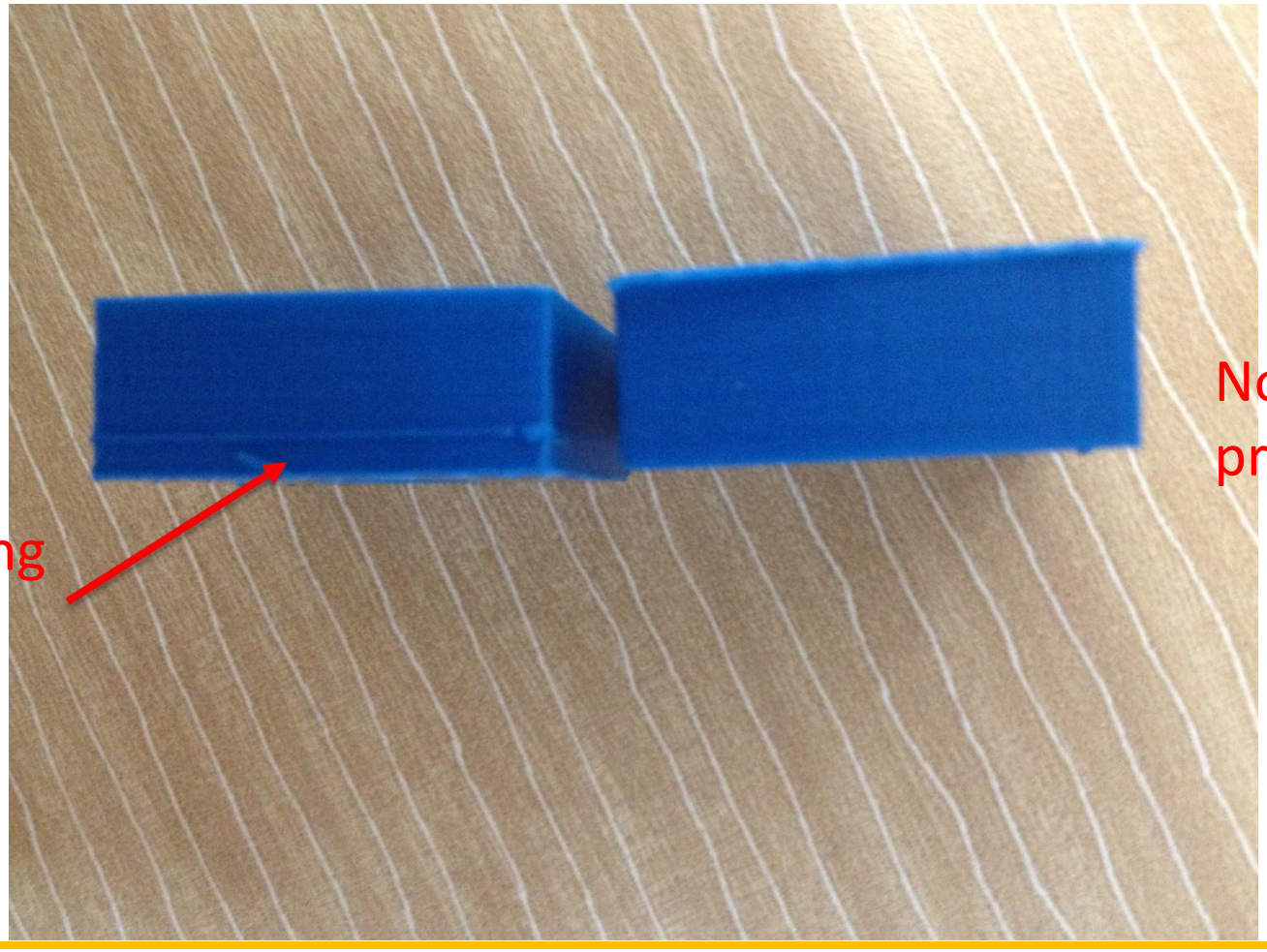




Blackout Continuing Printing Realization

With theoretical value

With actual value



Repeating printing

No Repeating printing

Difficulties And Solution

- The data received from encoder is 0-65536. That is, 16 digit in binary system.
- However, the Serial Transmission can only transmit 8 digit in binary system.
- So we split the original data into two parts: former 8 digit and latter 8 digit

Difficulties And Solution

- However, how can the receiver distinguish the former digit from latter digit?

	Original Data	Former 8 Digits	Latter 8 Digits
In Decimal System	258	1	2
In Binary System	0000000100000010	00000001	00000010

Difficulties And Solution

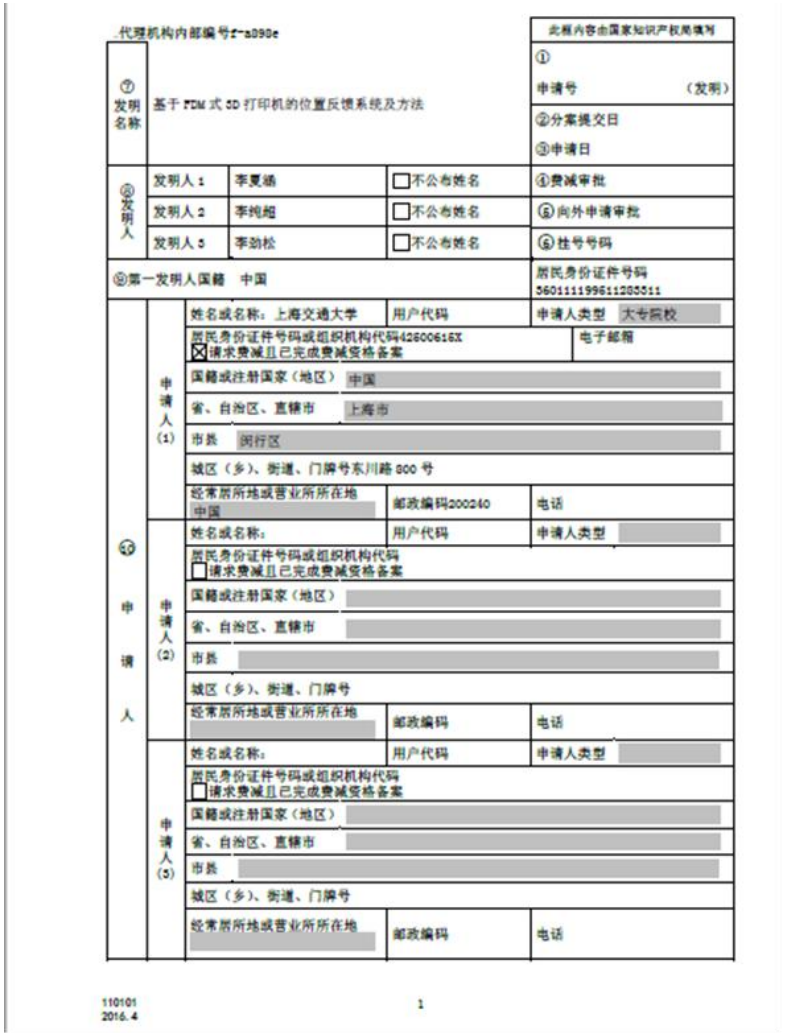
- We add 128 to the former digit as a label, since the latter digit cannot exceed 127.

	Original Data	Former 8 Digits	Latter 8 Digits
In Decimal System	129	1	2
In Binary System	0000001 0000010	0000001	0000010
Distinction		1+128 10000001	0000010

Project Progress After Mid-Check

- Realization of the position of stop point 2017/4/28-2017/5/28
- Realization of blackout continuing printing functions 2017/5/28-2017/6/28
- 3D printer testing 2017/6/28-2017/7/28
- Comparing with other types of 3D printers in market 2017/7/28-2017/8/28
- Optimization and conditioning according to the comparing result 2017/8/28-2017/9/28

Accomplishment



代理机构内部编号f-a090e

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⑦发明名称	基于 FDM 式 3D 打印机的位置反馈系统及方法			①申请号 （发明） ②分案提交日 ③申请日
⑧发明人	发明人 1	李夏扬	□不公布姓名	④费减审批
	发明人 2	李纯超	□不公布姓名	⑤向外申请审批
	发明人 3	李劲松	□不公布姓名	⑥生物材料
⑨第一发明人国籍 中国				居民身份证件号码 360111199611205511

⑩申请人	申请人(1)	姓名或名称：上海交通大学	用户代码	申请人类型 大专院校
		居民身份证件号码或组织机构代码42600616X ☒请求费减且已完成费减资格备案		电子邮箱
		国籍或注册国家（地区） 中国		
		省、自治区、直辖市 上海市		
		市县 闵行区		
		城区（乡）、街道、门牌号东川路 800 号		
		经常居所地或营业所所在地 中国	邮政编码200240	电话
	申请人(2)	姓名或名称：	用户代码	申请人类型
		居民身份证件号码或组织机构代码 □请求费减且已完成费减资格备案		
		国籍或注册国家（地区）		
		省、自治区、直辖市		
		市县		
		城区（乡）、街道、门牌号		
		经常居所地或营业所所在地	邮政编码	电话
	申请人(3)	姓名或名称：	用户代码	申请人类型
		居民身份证件号码或组织机构代码 □请求费减且已完成费减资格备案		
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		省、自治区、直辖市		
		市县		
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Thank You