Contents

[Conceptual design: 5](#_Toc9198958)

[2-Exteraction of material concepts : 7](#_Toc9198959)

[3-interface for selecting geometery and coordinates of prodructs. 9](#_Toc9198960)

[4- Moving in x direction : 10](#_Toc9198961)

[5- Sensing temperature conceptual design: 12](#_Toc9198962)

\*Need Identification :

Design Artifact

Cad model>> >> Required Material

Row material (PLASTISC)>> >> HEAT

Electrical energy >>

* Need Statement:” Convert row matrial to the required product in cost and time effictive way”
* 1- Function decomposition.

2- Requirement and specification:

1- Entering row matrial:

|  |  |
| --- | --- |
| Requirement | Specification |
| Small size with no large blocks | ( - ) cm3 |
| Easy access , doesn’t take long time | ( - ) sec |
| Few number of components for  Entering mechanism | ( - ) |
| Availablity of component in market |  |
| Low cost | ( - ) $ |

2-Extraction of material:

|  |  |
| --- | --- |
| Requirement | Specification |
| Rate of extracton | ( - ) mm3 /sec |
| Acceptable temperature generation | ( - ) oc |
| Continous extraction |  |
| Availablity of component in market |  |
| Low cost | ( - ) $ |
| Stop extraction material response  When part is discontinuous | ( - ) sec |

3-Moving in x direction :

|  |  |
| --- | --- |
| Requirement | Specification |
| Continuous motion |  |
| Range of motion | 0 >> 20 cm |
| Speed range | 20 rpm >> 60 rpm |
| No friction | Easy movement availability |
| Low vibration | <= HZ |

4-Moving in y direction :

|  |  |
| --- | --- |
| Requirement | Specification |
| Continuous motion |  |
| Range of motion | 0 >> 20 cm |
| Speed range | 20 rpm >> 60 rpm |
| No friction | Easy movement availability |
| Low vibration | <= HZ |

5-Moving in z direction :

|  |  |
| --- | --- |
| Requirement | Specification |
| Continuous motion |  |
| Range of motion | 0 >> 20 cm |
| Speed range | 20 rpm >> 60 rpm |
| No friction | Easy movement availability |
| Low vibration | <= HZ |

6- Controlling the movement

|  |  |
| --- | --- |
| Requirement | specification |
| Closed loop control | 30◦ |
| Reading measurement [ position,speed ] | Every (0.1s>>0.2s) |
| Low cost | 50$ >> 250$ |
| Sequence control for three movemnets |  |
| Speed of action | 0.5 s >>1 sec |
| Accurate of reading measurements | +- 1% |

7- Sensing temperature

|  |  |
| --- | --- |
| Requirement | specification |
| Accuracy of sensing | +- 2% |
| Resolution of sensing | +- 0.5% |
| Low cost | 20$ >> 70$ |
| Fast response |  |
| Max . measure temperature |  |
| Repeatability | 750$ >> 1000$ |

## Conceptual design:

1-Entering the material:

1. Gringing
2. Entering it as block
3. Melting the material
4. Pulling the material
5. Convert the material into small parts then vacuum sucrion of parts
6. Using the powder material and conveyor
7. Using robot to enter material

#### Solution space:

C1: Entering the material with safe way (don’t hurt yourself)

C2: Entering the material with low cost and power [30$>> 50$]

#### KT Matrix Decision analysis:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Must | a | b | d | h |  |
| Entering material as small size (no blocks) | **Go** / no go | Go/ **no go** | **Go** / no go | **Go** / no go |  |
| Output signal | **Go** / no go | **Go** / no go | **Go** / no go | Go / **no go** |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Need | weight | Rate | Score | Rate | Score | Rate | Score | Rate | Score |
| compact | 9 | 7 | 56 |  |  | 6 | 56 | 3 | 27 |
| time < 40s | 9 | 8 | 72 |  |  | 5 | 54 | 4 | 36 |
| Component < 3 | 7 | 7 | 45 |  |  | 4 | 28 | 4 | 28 |
| Total |  |  | 177 |  |  |  | 138 |  | 91 |
|  |  |  |  |  |  |  |  |  |  |

**The best solution is a .**

#### Pugh Method

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Criteria | DATUM | a | b | d | h |
| Entering material as small size (no blocks) | Datum | +1 | -1 | +1 | +1 |
| time < 40s | Datum | +1 | -1 | -1 | -1 |
| Cost < $ | Datum | +1 | 0 | -1 | -1 |
| compact | Datum | +1 | 0 | -1 | -1 |
| Positive | Datum | 4 | 0 | 1 | 1 |
| Negative | Datum | 0 | 2 | 3 | 3 |

**The best solution is a .**

### 2-Exteraction of material concepts :

1. Lever
2. Foots
3. Plungers
4. Pistons
5. Vacum
6. Screw with end disck
7. Molting material until become as a liquid

#### Solution space:

C1-exteraction of material as coherent material

C2-exteraction of material with safe way (don’t hurt yourself )

C3-Easy to change the program

#### KT Matrix Decision analysis:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Criteria | 1 | 3 | 4 | 5 | 6 |
| \*must |  |  |  |  |  |
| Low cost | **Go**/ no go | **Go** / no go | **Go** / no go | Go / **no go** | **Go** / no go |
| Time | **Go**/ no go | Go / **no go** | **Go** / no go | **\_\_\_** | **Go** / no go |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | |  |  |  | |  |  |
|  |  | 1 | |  | 4 |  | |  | 6 |
| Need | Weight | Rate | | score | rate | score | | Rate | score |
| Rate of exteraction [7mm3/s] | 8 | 8 | | 64 | 7 | 56 | | 5 | 40 |
| Small size mechanism [accuiped space (5\*2\*3 cm)] | 9 | 8 | | 72 | 7 | 63 | | 6 | 54 |
| Max. pressure of exteraction 150 bar | 7 | 9 | | 63 | 8 | 56 | | 84 | 28 |
|  |  |  | |  |  |  | |  |  |
| Total | | | 199 | | | | 175 122 | | |

**The best solution is • lever.**

#### Pugh Method

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Criteria | Base line | 1 | 4 | 6 |
| Low cost [20$ >> 50$ ] | 0 | + | 0 | + |
| Time [0 < 2 s] | 0 | + | + | - |
| Rate of exteraction | 0 | -+ | 0 | + |
| Small size | 0 | - | + | + |
| Max. pressure | 0 | + | + | - |
| Positive | 0 | 4 | 3 | 2 |
| Negative | 0 | 1 | 1 | 3 |

**The best solution is lever .**

### 3-interface for selecting geometery and coordinates of prodructs.

1. Using push button to draw shapes .
2. STL program software [editor].
3. Draw the geometric shapes and scan it .
4. Draw shapes with oen on screen and choose the thickness of fit .
5. Drawing lines with voice command .

#### Solution space:

C1-digital interface

#### KT Matrix Decision analysis:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Must | | 2 | | 3 | | 4 | | 5 |
| Availability to Change measurement angle | | **Go** / no go | | Go / **no go** | | **Go** / no go | | **Go** / no go |
| Wants | weight | Rate | Score | Rate | Score | Rate | Score | Rate score |
| Easy to the user | 9 | 9 | 81 |  |  | 6 | 54 | 5 45 |
| Response time of exectution <0.0001 | 10 | 10 | 100 |  |  | 7 | 70 | 6 60 |
| Total |  |  | 181 |  |  |  | 124 | 105 |

#### Pugh Method

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| criteria | baseline | 2 | 3 | 4 | 5 |
| Availability to Change measurement angle | 0 | +1 | -1 | +1 | +1 |
| Easy to the user | 0 | +1 | -1 | -1 | 0 |
| Response time of exectution <0.0001 | 0 | +1 | 0 | -1 | -1 |
| positive |  | 3 | 0 | 1 | 1 |
| negative |  | 0 | 2 | 2 | 1 |

### 4- Moving in x direction :

1. Using screw and nut . with stepper motor
2. Using omni wheel with stepper
3. Using car wheel to move the axis
4. Using screw and nut with dc motor
5. Use wings with screw and bearing and motor with dc motor
6. Using hydraulic motion to move the part
7. Using benumatic motion

#### Solution space:

C1- controlling the degree of motion of screw

C2- less component <3

#### KT Matrix Decision analysis:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Must | | | 1 | | | 2 | | | 3 | | | 4 | |
| High durability | | | **Go** / no go | | | **Go** / no go | | | Go / **no go** | | | **Go** / no go | |
| Wants | weight | Rate | | score | Rate | | score | Rate | | score | Rate | | Score |
| Torque | 8 | 8 | | 64 | 8 | | 64 |  | |  | 6 | | 48 |
| Accuracy | 9 | 9 | | 81 | 9 | | 81 |  | |  | 7 | | 63 |
| Wide space movement | 4 | 10 | | 32 | 10 | | 80 |  | |  | 4 | | 32 |
| High speed | 7 | 7 | | 49 | 7 | | 49 |  | |  | 5 | | 35 |
| Total |  |  | | 226 |  | | 274 |  | |  |  | | 178 |

**The best solution is DC motor (servo).**

#### Pugh Method

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Criteria | Person moves it | Stepper motor | Dc motor | Linear actuator | Bully and wires |
| Durability | Datum | +1 | +1 | -1 | +1 |
| Torque | Datum | +1 | +1 | -1 | -1 |
| Accuracy | Datum | +1 | +1 | 0 | 0 |
| Wide space | Datum | -1 | +1 | -1 | -1 |
| Negative |  | 1 | 0 | 3 | 2 |
| Positive |  | 3 | 4 | 0 | 1 |

**The best solution is omni wheel .**

### 5- Sensing temperature conceptual design:

1. Touching the material with human.
2. Thermostat.
3. Thermistor
4. Resistive temperature detectors (RTD).
5. Thermocouple

Solution space:

C1-accurate measurement

#### KT Matrix Decision analysis:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Must | | | 2 | | | 3 | | | 4 | | | 5 | |
| Cost <10$ | | | **Go** / no go | | | **Go** / no go | | | Go / **no go** | | | **Go** / no go | |
| Needs | weight | Rate | | score | Rate | | score | Rate | | score | Rate | | Score |
| Temperature  200 >> 1800 oc | 7 | 3 | | 21 | 5 | | 35 |  | |  | 10 | | 70 |
| Accuracy  0.05 >> 1.5 oc | 8 | 6 | | 48 | 8 | | 64 |  | |  | 3 | | 24 |
| Longterm stability @ 100oc >> 24 years | 6 | 5 | | 30 | 3 | | 18 |  | |  | 4 | | 24 |
| Response time 0.1 >> 10 s | 8 | 6 | | 48 | 8 | | 64 |  | |  | 5 | | 40 |
| Total |  |  | | 147 |  | | 181 |  | | 253 |  | | 158 |

**The best solution is Thermistor.**

#### Pugh Method

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Criteria | Person moves it | Stepper motor | Dc motor | Linear actuator | Bully and wires |
| Response time 0.1 >> 10 s | Datum | 0 | +1 | 0 | -1 |
| Cost <10$ | Datum | +1 | +1 | -1 | +1 |
| Temperature  200 >> 1800 oc | Datum | 0 | +1 | -1 | +1 |
| Accuracy  0.05 >> 1.5 oc | Datum | 0 | +1 | 0 | 0 |
| Longterm stability @ 100oc >> 24 years | Datum | +1 | 0 | +1 | -1 |
| Negative |  | 0 | 0 | 3 | 1 |
| Positive |  | 4 | 3 | 1 | 2 |

**The best solution is thermistor.**