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<u>Abstract</u>

The starting point for an (x-y) table which is controlled according to loop system has been fixed in (0,0) point in present work so, it will be back up automatically to this reference point after each duty cycle which has been implemented yet.

تحديد نقطة البدء لحركة منضدة بالاحداثي (السيني- الصادي)

<u>الخلاصة</u>

تم في هذا البحث تحديد نقطة البدء لمنضدة الاحداثي (السيني – الصادي) والتي يتم السيطرة على حركة هذه المنضدة تبعا لنظام الحلقة المفتوحة, حيث تقوم المنضدة بالرجوع تلقائيا الى نفس هذه النقطة (نقطة الاصل) بعد كل عملية تنجزها المنضدة.

<u>Introduction</u>

The origin point is a very important parameter to improve a high accurate performance in an (x-y) table which is controlled according to open loop system. It will be easily when the table is derived by stepping motors, the table which is used in this research is derived by two servo DC motors. However, the reliable an interfacing card is designed to interface the motors of a table with a personal computer to derive the motors in high performance. For this purpose, software program corresponding with a designed interfacing card, at the end the (x-y) table will startup and back up to the same point which is called the reference point after the table was finished its tasks to begin from this reference point at each new task.

<u>Interfacing card</u>

The interfacing card is designed using four transistors type NPN to drive the motors of an (x-y) table. Table (1) shows the specifications tof an used transistors. Each two transistors are used to derive one motor to ensure each motor derives in two directions clockwise and anti clockwise depending on the commands of a parallel port of a personal computer. (i.e. each motor will turn on clockwise or anticlockwise

depending on the current direction of motor). This is implemented by generating a Gray code by a personal computer. i.e. this code drives the base of transistor to make a transistor operate in saturation mode to drive one or two motors sultanumouisly in one or more direction [1]. Table (2) discuss how a gray code drives the motors in one or in more direction.

Table (1) specifications of an transistors used

model	FZT1048A
family	BJT-NPN
description	Ic (max.)= 50 mA hfe (min)= 50 hfe(max.)= 1200

Value in hexadecimal	Gray code	x-axis motor			y-axis motor		
		Tr.1	Tr.2	rotation	Tr.1	Tr.2	rotation
1	0001	Sat.	Cut.	c.w.	Cut.	Cut.	…………
3	0010	Cut.	Sat.	A.c.w.	Cut.	Cut.	…………
7	0100	Cut.	Cut.	…………	Sat.	Cut.	c.w.
6	0101	Sat.	Cut.	c.w.	Sat.	Cut.	c.w.
4	0110	Cut.	Sat.	A.c.w.	Sat.	Cut.	c.w.

F	1000	.Cut	.Cut	………….	.Cut	.Sat	.Ac.w
E	1001	.Sat	.Cut	.c.w	.Cut	.Sat	.A.c.w
C	1010	.Cut	.Sat	.A.c.w	.Cut	.Sat	.A.c.w

Table(2) gray code of motor drivers

A good idea when a potentiometer 200 KΩ is used to make a transistor is cutting off when the table reaches at the reference point to avoid motor damage, (i.e. the potentiometer will be used as a voltage divider to cutoff the base of transistorto turnoff the motor). A stepping of a potentiometer is synchronized with a motor so, the voltage applied on the base of a transistor will be zero volt when the motor return the table to the reference   point, as a result the transistor will be cutting off to turn off the motor. But the other transistor will be in saturation mode to drive the motor in other direction to move the table in +x direction. The same method is applied on the motor of Y-axis. We find that, the table reaches the origin point, the two motors will be turned off in -X and -Y directions to prevent the motors from the vibration or coil damage which is results from high current which is flow through motor coil if the motor is continuous turning on when the table is stopped. While the two motors will be always ready to turn on to drive table in +X and +Y directions.
         .   .Table (3) shows the motors of (x-y) plotter specifications

Table(3) motor specifications

Rated voltage	volt DC 6
Rated current	mA 40
Coil resistance	Ω 150

Two potentiometers are used as an electronic micro switch. To improve that the potentiometer must be gearing with a motor accurately so, the potentiometer rotate according to motor revolution numbers. The revolution numbers of motor was computed according to the followed equation [2].

$$P_{max.} = (T*N*2\pi)/60 \ldots\ldots\ldots\ldots(1)$$

Where :- $P_{max.}$ represent the maximum power , T is the maximum motor torque , and N is the revolution number per minute.

When the potentiometer makes a voltage on the base of transistor equal zero volt, that makes a high current pass through the potentiometer to the ground, this will cause damage buffer of a parallel port of a personal computer [3]. To avoid that the resistor a 10 KΩ is used to ensure a maximum current is passing when the potentiometer cutting the transistor will be less than 1mA. As a result, the buffer of a parallel port of a personal computer is protected. Finally the four AND gates are used to ensure each motor stop when the table reaches the desired point. This is done by connecting one input terminal of each gates to the first terminal of a parallel port of a personal computer which is called a strobe pin. Figure (1) depicted the interfacing circuit. This circuit is tested carefully by Multisim10 program to ensure a perfect results will be done when this project is applicated as a result for that, an excellent results are obtained when this circuit is tested.
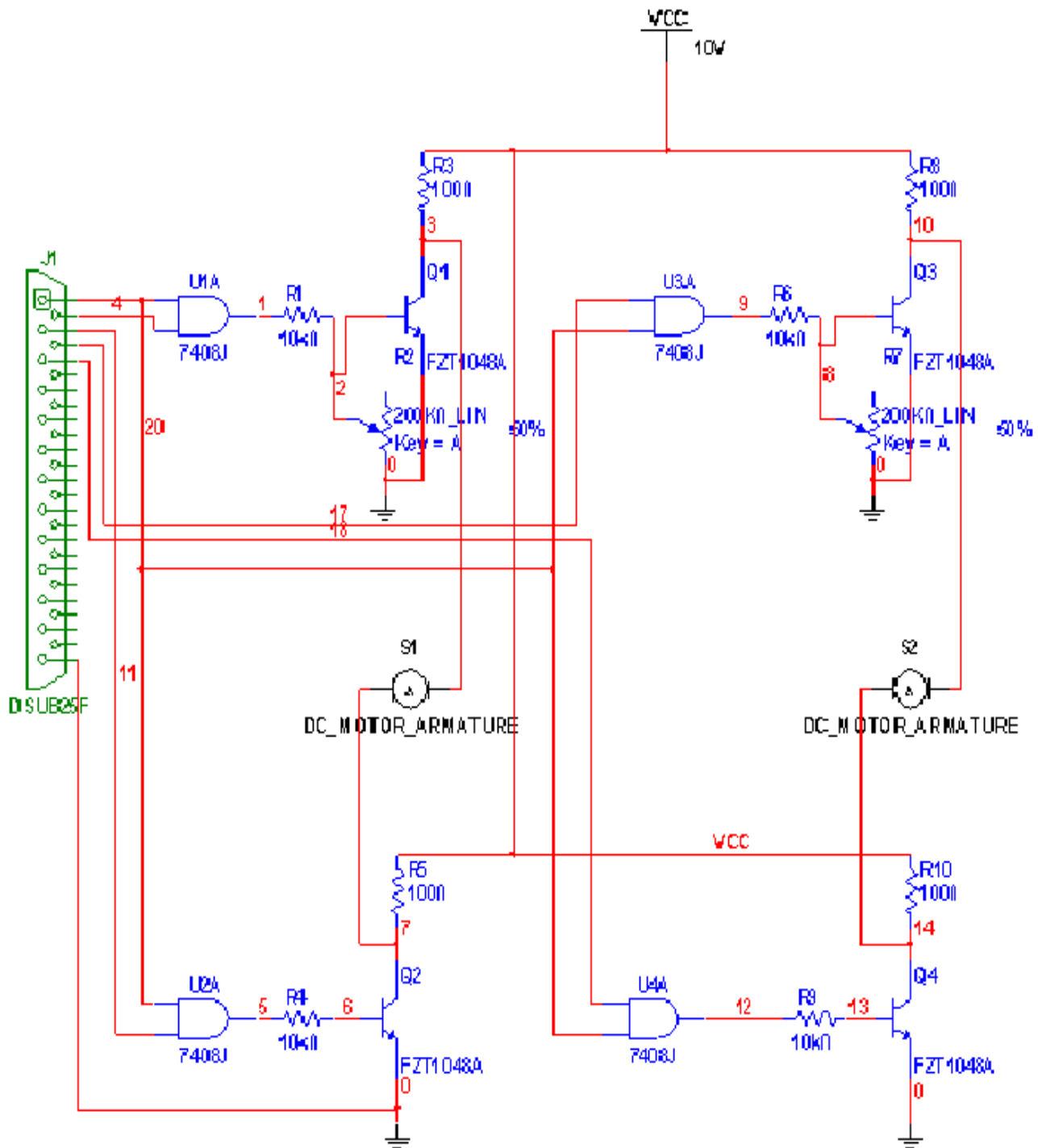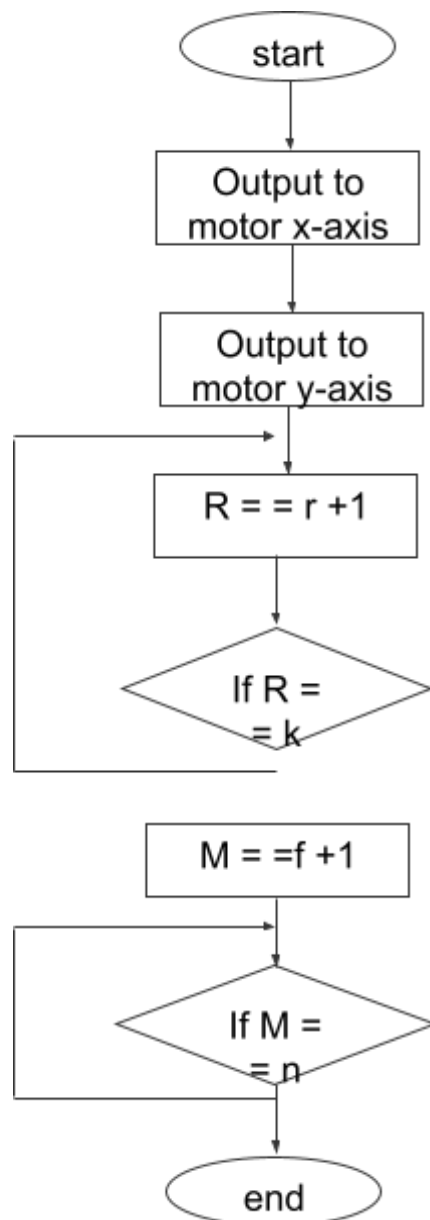
Figure (1) the interfacing card circuit

<u>Software program</u>

The software program is designed to drive an (x-y) table toward the origin point. This software program just need to detect the number of an output signals which is permit to drive an (x-y) table from extreme range to the starting

point (0,0) of table. This is done by written two reliable values of two counters (
each counter for each motor) of software program [4]. As we see in fig.(2.

```
        ┌──────────┐
        (  start   )
        └──────────┘
              │
              ▼
      ┌──────────────┐
      │  Output to   │
      │ motor x-axis │
      └──────────────┘
              │
              ▼
      ┌──────────────┐
      │  Output to   │
      │ motor y-axis │
      └──────────────┘
              │
              ▼
      ┌──────────────┐
      │  R = = r +1  │
      └──────────────┘
              │
              ▼
          ◇ If R =
            = k ◇
              │
              ▼
      ┌──────────────┐
      │  M = =f +1   │
      └──────────────┘
              │
              ▼
          ◇ If M =
            = n ◇
              │
              ▼
        (   end    )
```

Discussion and
Conclusions

ftware program

1- A potentiometer is using instead of a micro switch to improves two
features, one, the potentiometer is more flexible than a micro switch as a
components attached to (x-y) table or (x-y) plotter to suite an (x-y) table
applications, second a potentiometer is a more accurate than a micro switch
because the potentiometer is gearing with the motor so the steps of a
potentiometer is a synchronize with a motor steps. More details, the
potentiometer should be cutting the transistor or turn off the motor in the
reference point automatically (exclusive in reference point) whatever the

processor continues to drive the motor. This second feature is very important when the motor is controlled by open loop system mode to ensure the table reaches the reference point without missing any steps. As a result, the table will transmit to a devoir point without missing any steps.

2- The design of an interfacing card can not be need to a complicated software, the system (electronic circuit & the x-y table) just need the appropriate counter to drive a table from the extreme primitive point which can be arrived the table to the origin point (0,0). That is implemented by computing the number of revolution of the two motors to designed a counter by a software program to return the x-axis and y-axis from the latest point to the primary point in the table.

3- Using a four bit NAND gates makes the table stopped automatically when the task is over. That's reduces the commands of a software program therefore, the software program is become very easily.

4- For all above results, we can see this design offers low costs for where the components which is needed to build up an interfacing card also, a simplest implementation of an electronic circuit of an interfacing card and a simplest buildup a software program where, it needs a little commands to drive the (x-y) table toward the origin point or reference point. More than that, this design is not applicated to (x-y) table only but it is be very reasonable and more flexible for (x-y) recorder when using as a (x-y) table.

5- Number of revolution of potentiometer can be computed easily by compute the time of table cycle which is back up the table from an extreme point to the origin point and divide the number of rotation which is computed from eq. (1) by this time. Number of revolution of potentiometer is very important parameter in using a potentiometer which is have appropriate number of revolution to appropriate number of motor revolution.

References

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