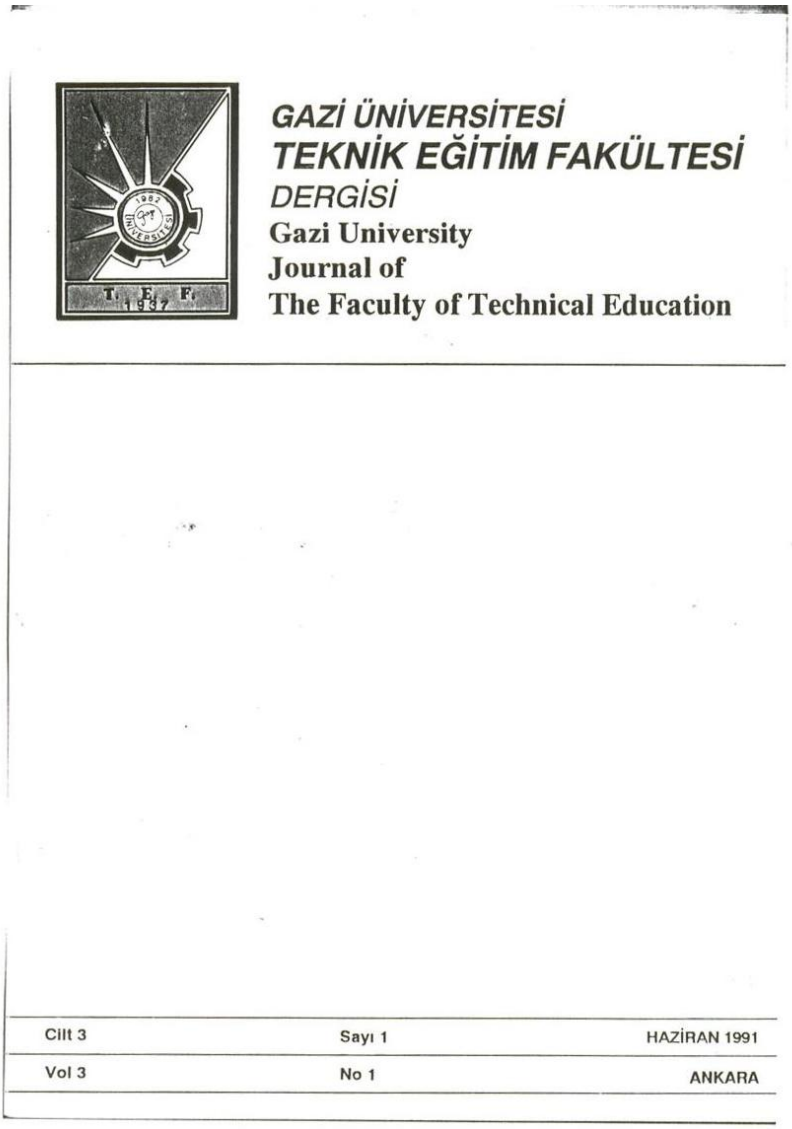
Varol, A., Carabott, V., Delannoy, P., Vivet, M.: “Control of Temperature with a Robot”, Matik'97, Makine Tasarım Teorisi ve Modern İmalat Yöntemleri Konferansı, Gazi Üniversitesi, Teknik Eğitim Fakültesi ve Teknoloji Araştırma ve Eğitim Merkezi, Ankara, 15-16 Eylül 1997, Bildiri Kitabı, 1-5



Varol, A., Carabott, V., Delannoy, P., Vivet, M.: "Control of Temperature with a Robot", Matik'97, Makine Tasarım Teorisi ve Modern İmalat Yöntemleri Konferansı, Gazi Üniversitesi, Teknik Eğitim Fakültesi ve Teknoloji Araştırma ve Eğitim Merkezi, Ankara, 15-16 Eylül 1997, Bildiri Kitabı, 1-5

2.4. CONTROL OF TEMPERATURE WITH A ROBOT

ABSTRACT

This article is a result of a project which completed at Med-Campus, International Summer School on Computer-Based Cognitive Tools for Teaching and Learning. LOGO Programming Language is used to control of a robot. Using LOGO Programming Language has some advantages comparing to other programming languages. First of all, the terminology of the LOGO is very easy. Controlling of a robot can be done with any other language or symbols, too.

All kinds of the robot-movements are controlled using a number of the procedures. In this study some important procedures will be given with their definitions. The role of interface and Binary/Analog coding and planning a robot in a way with different kind of function will be explained.

1. INTRODUCTION

To maintain constant temperature some materials are necessary. They are a light/lamp which can heat when light on, a thermoresistor whose resistance varies according to temperature and fan (propeller) which able to blow air to cool the device. All kinds of materials which is used by this project are available using Fischertechnik construction boxes [1,2].

A negative temperature resistance (Thermistor) is heated with the lamp. If the temperature goes up because of light, the value of the resistance goes down because of the NTC (Negative Temperature Coefficient) goes down.

The fan begins to rotate in order to cool the resistance when the temperature increases which means getting smaller for the resistance. If

temperature goes down too much, the NTC is heated by lighting on the lamp.

2. PHYSICAL DESCRIPTION

The robot which is constructed has a vertical arm on where the fan is mounted. The fan can be moved up and down by controlling with LOGO programming language. There are two switches on vertical arm to control the up and down movements of the fan. This allows blowing more or less air. An interface links the computer to the robot and the robot is wired by using a plug-box. The software to control the robot is written in LOGO. The Picture of the mounted robot is shown in Figure 1.

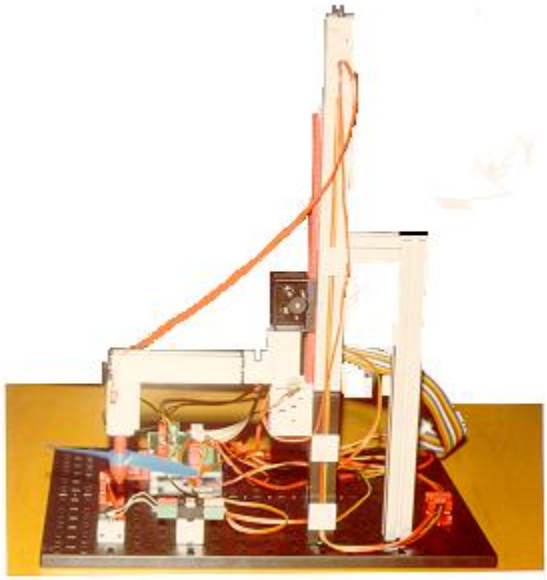


Figure 1: The picture of the mounted robot for Control of Temperature

3. THE FLOW CHART OF WORK

The flowchart of the work is given as follows (Figure 2):

Planing the work		
Defining the necessary parts		
Defining of movements of motors, switches, lamps&technical decisions as follows		
Movements	**Motors**	**Switches**
Up Down Rotation of the fan Lamp Light on/off Resistance (NTC)	M1 M1 M2 M3 EY?	E1 E1
Select the parts from Fischertechnik boxes and numbering all of parts		
Mounting		
Check the status of the motors and switches, step by step		
Writing the part software and checking for each step separately		

Figure 2. The flowchart of the work.

4. ACTIONS AND PROCEDURES

The actions of the system can be defined as heating (light on), cooling, movement of the fan and auto control. A flow chart of the actions is given in Figure 3.

The actions of the systems			
Heating	**Cooling**	**Movement of the fan**	**Auto control**
1. Light on	1. Turning	1. Down	
2. Light off	2. Stopping	2. Up	

Figure 3. Flowchart of the actions.

The procedures of the system are specified under six step shown below. At the beginning each procedure is written separately. Each procedure means one action. If all procedures are combined in one program together, the movement of the system will be continuous.

```
TO LIGHTON
MCCW "M3
END
```

Here is light on procedure (MCCW= Motor Counter Clock Wise)

```
TO LIGHTOFF
MSTOP "M3
END
```

The light is off.

```
TO HELIXLEFT :T
MCCW "M2 WAIT :T
MSTOP "M2
END
```

This procedure allows to turn the fan in counter clockwise direction for T seconds. Then the M2 motor stops.

```
TO CONTROL1 :LV :HV
MAKE "EY EY?
IF :EY< :LV [LIGHTOFF HELIXLEFT 1] []
IF :EY> :HV [LIGHTON] []
IF AND :EY < :HV :EY> :LV [PR :EY]
CONTROL1 :LV :HV
END
```

The meanings of some parameters used in the program above are:

LV: Low value

HV: High value

EY: A value for NTC (Negative temperature coefficient)

The actual value of the captor EY, given by the function EY?, is placed by the procedure into the variable (global) EY.

The program lets assign EY variable to EY? and EY? is functional procedure of LOGO which gives to LOGO the value (actual on call) of the captor (the thermoresistor in our case) via the analog input EY of the interface. If EY value less than low value (LV) which is given by user, the light is switched off and fan rotates counter clockwise 1 second to cool around, but; if EY value is greater than high value (HV) also given by the user, the light is switched on. The only EY values which are displayed on the screen are those between LV and HV as given by the user. Then the loop continues.

During the design and testing phase, checking the range of values returned by the thermoresistor is useful and observing the fact that resistance decreases when temperature increases is interesting. So a specific tool to observe these values and phenomena can be designed and written in LOGO.

This procedure lets work OBSERVEVALUES part program with the parameter T and B. Here T is time as seconds and B can have two values 1 or 0. If the value of B is 1 then the fan is turning counter clockwise and blows air else the fan is stopped.

```
TO OBSERVEVALUES :T :B
```

```
MSTOP "M2
LIGHTON WAIT :T
LIGHTOFF
IF EQUALP :B 1 [HELIXLEFT :T]
REPEAT :T/2 [PR EY? HELIXLEFT 2 WAIT 2]
END
```

This procedure decides whether the fan rotates or not through controlling the M2 motor. During T seconds is light on and then the light off, and if B has the value of 1, the fan rotates T seconds in counter clockwise direction to cool the thermistor. In REPEAT line T/2 times EY value will be printed on the screen and fan will rotate counter clockwise for 2 seconds waiting 2 seconds phases. This "repeat" action allows observations of the increasing values of EY? while the temperature is decreasing.

```
TO OV :T :B
OBSERVEVALUES :T :B
END
```

OV is used a short name instead of OBSERVEVALUES during the debug phase.

5. CONCLUSION

The role of interface and Binary/Analog coding is very important on Control Technology. The design of an instrument to measure phenomena using an analog captor, making the correct choice of parts and debugging the system. Controlling the robot with LOGO programming language can be performed.

REFERENSES

[1] Manipulator Assembling Handbook, LIUM, Loboatoire d’Informatique, Université du Maine, B.P. 535 - 72017 LE MANs

[2] Delenoy P., Martial V.; Specifications for Cubsort, A Sorting Machine For Cubes, Cognitive TECHnologies for Education, Med Campus, 1994