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Uses

Specimen and Culture Refrigerators can be found in many industries including:
- Laboratory
- University
- Research Institution
Why Use Temperature Control?

- Culture Storage
- Experiment preparation
- Specimen harvesting
- Culture Growth
- Research
- Environmental Simulation
Temperature Control

Drawbacks

- Requires expensive equipment
- Constant monitoring required
- Around the clock on-call researcher
- Need to work around specimen temperature
- Require constant sample checking
INTRODUCING THE AUTONOMOUS REFRIGERATOR ROBOT
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Photoresistor

- Variable Resistor
- Changes Resistance with light
Thermistor

- Variable Resistor
- Changes Resistance with Temperature
**H-Bridge**

- Used to control a high current device
- Can control current in two directions for DC motor control
Button Circuit

- Vdd pulls the Basic Stamp normally high
- The switch is NO
- When the button is pressed the pin goes to ground and BS senses it as a low
Parallax LCD

- Interacts with the Basic Stamp using only one Pin
- Can display information about program selection, can location and temperatures
- Uses 2 BS pins per motor
- Isolated BS voltage from external source
- External voltage needs to be higher than BS 5v to activate the MOFSETs
Servo Motors

• Can control speed, location and position with one BS pin
• Can operate using BS current and voltage
RC Circuit

- Used to measure the resistance of a variable resistor with basic stamp
- Used for photoresistor and thermistor
- Capacitor sizing is used to calibrate the range of resistance
Op-Amp

- Used in conjunction with the photoresistor
- Sends either Vss or Vdd to BS depending on resistance in the photoresistor
- Used to stop the robot quickly on the rails with only a small change in resistance
Main

- Sets values for important variables
- Calls starting functions
- Branches to selected option

```
DO
LOWERTEMP = 0
COLDEST = 0
GOSUB START
GOSUB OPTION
GOSUB CHECKCANS
IF POSCANS = 0 THEN GOTO NOCANS
IF FUNCTION = 1 THEN GOSUB GETCOLDEST
IF FUNCTION = 2 THEN GOSUB FIRSTCOLD
IF FUNCTION = 3 THEN GOSUB FREEZING
LOOP
```
• Shows the options

• Asks user to choose one
Option

- Reads buttons
- Displays the function selected

```
OPTION: 'SELECTED INSTRUCTION

SEROUT LCDPIN, 84, [12]
PAUSE 5
SEROUT LCDPIN, 84, ["Function: ", DEC FUNCTION]

DO

    IF ( BUTTON1 <> PRVSVVALUE1 ) AND ( PRVSVVALUE1 = 0 ) THEN

        FUNCTION = FUNCTION + 1
        IF FUNCTION > 3 THEN FUNCTION = 1
        SEROUT LCDPIN, 84, [138, DEC FUNCTION]

    ENDIF

PRVSVVALUE1 = BUTTON1
PAUSETIME = 2
GOSUB PAUSESUB

LOOP UNTIL BUTTON2 = 0

SEROUT LCDPIN, 84, [12]
PAUSE 5
SEROUT LCDPIN, 84, ["Function", 13, "selected: ", DEC FUNCTION]

RETURN
```
Check Cans

- Detects if there are cans in the positions
- Saves positions in variable POSCANS

```
CHECKCANS:
PAUSETIME = 1
POSCANS = 0

HIGH POS1
GOSUB PAUSESUB
RCTIME POS1, 1, TIME
IF TIME > 500 THEN POSCANS = POSCANS | %1

HIGH POS2
GOSUB PAUSESUB
RCTIME POS2, 1, TIME
IF TIME > 10 THEN POSCANS = POSCANS | %10

HIGH POS3
GOSUB PAUSESUB
RCTIME POS3, 1, TIME
IF TIME > 500 THEN POSCANS = POSCANS | %100

DEBUG DEC POSCANS, CR
```

RETURN
Arm Down/Up

- Controls the DC motor of the arm
- Different time if holding can

```plaintext
ARMDOWN:
HIGH CSARM
LOW PINARMUP
HIGH PINARMDOWN
IF HASCAN = 1 THEN
  PAUSETIME = 45
  GOSUB PAUSESUB
ELSE
  PAUSETIME = 53
  GOSUB PAUSESUB
ENDIF
LOW CSARM
LOW PINARMDOWN
RETURN
```
Close/Open Claw

FOR X = 1 TO 100
  IF BUTTON3 = 0 THEN GOSUB EMERGENCY
  PULSOUT CLAW, 650
  PAUSE 20
NEXT
RETURN

- PWM pulses to control claw’s servo
Pausesub

- Created to make possible the sensing of emergency button while pausing

- Pauses for 100 milliseconds and checks button
Get Coldest

- Piece of code similar in every function
- Checks if current position has can
Get Coldest

- After sensing temperature, records it and position if lowest

- Variable Temp is related to time of RC circuit. The higher the value, lower the temperature

```plaintext
IF LOWERTEMP = 0 THEN
    LOWERTEMP = TEMP
    COLDEST = POSITION
ENDIF
IF TEMP > LOWERTEMP THEN
    LOWERTEMP = TEMP
    COLDEST = POSITION
ENDIF
```
Get Coldest

- Checks if current position is last with cans
- If so, goes to pick can routine
Pick Can

- Checks if current position is position of coldest can
- If so, picks can and goes back to start position
First Cold Can

- Similar to get coldest
- Gets cold can as soon as it finds it
- If none is found displays message

IF POSITION = 1 AND POSCANS = 1 THEN
GOSUB NOCOLDCANS
GOTC TOSTART
ENDIF
Freezing

- Similar to previous
- Never gets a can
- Shows warn if temperature is below freezing temperature

```plaintext
IF TEMP > FREEZETEMP THEN
  SEROUT LCDPIN, 84, [12]
  PAUSE 5
  SEROUT LCDPIN, 84, ["WARNING!"]
  PAUSETIME = 10
  GOSUB PAUSESUB
  SEROUT LCDPIN, 84, [12]
  PAUSE 5
  SEROUT LCDPIN, 84, ["FREEZING CAN", 13, "ON POSITION ", DEC POSITION]
ENDIF
```
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Marketing / Conclusion
• More compact design can be achieved with better materials
• All components need to be rated for colder temperatures
• A larger sample size will need to be able to be observed
• More precise temperature reading capabilities.
• Additional sensors to make possible safe reset:
  ◦ Claw state
  ◦ Arm position
  ◦ End of trail
Summary

- Increased productivity
- Lower operating costs for labs
- More precise readings
- Larger quantities capable of being observed

A product no lab will be without!!!
Thank you