Automate the Home

Automatic Pump Controller

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INTRODUCTION:

It is very common in houses in high terrain or high rise buildings, that the public water supply does not have enough pressure to get the water into the overhead tank. The water will be collected in a underground tank and lifted to the overhead tank by a pump. The pump must do the pumping operation whenever the water level in the overhead tank is empty and should stop pumping when filled. This operation can be performed manually by a start/stop switch for the pump motor, or the operator can control the pumping. He should constantly monitor the water level in the overhead tank to prevent overflowing. Similarly, he should ensure that there is water in the sump before starting the pump. It is very convenient to incorporate an automatic setup for pumping.

Here is a circuit that automatically controls the pump so that an efficient water supply is maintained. All possible protection features and alarms are added to this PICmicro™ microcontroller based system. The following are some of the essential features for a pump controller.

1. Pump should start pumping immediately after the water level in overhead tank is lower than the lower limit.
2. Pump should stop pumping when tank is filled.
3. Pump should not start if there is no water in the sump to prevent dry run.
4. Motor must stop if the pump is not delivering water due to any problem.
5. Motor should not run continuously more than the safe run time and it should stop after the set running time is over.
6. The pump can be controlled manually at any time by using the start/stop (manual) button.

Apart from the above, the following protective features are also incorporated.

1. Prevention of malfunctioning from fault in the sensors
2. Various alarms to indicate the status of the pumping system.

APPLICATION OPERATION:

The PICmicro™ microcontroller is provided with the following inputs to sense the various conditions:

1. Presence of water in the sump
2. Low water in overhead tank
3. Water filled in tank.
4. Pump ok
5. Manual control switch.

The inputs 1 to 3 can be easily obtained either by using float switches as sensor or by dipping probes as sensors in the O/H tank or in the sump. Presence of water at a level can be sensed by checking conductivity between the pair of probes erected at that level. A simple transistor and an Opto-coupler are sufficient for the input conditioning. A simple arrangement is shown in the circuit.

Outputs available form the controller are used to operate the starter of pump and to activate a buzzer.

Since the number of external lines are less than needed, the SUMP_OK input and the buzzer output are sharing the same pin. This pin, GP5, is assigned as output only when an error condition is detected.

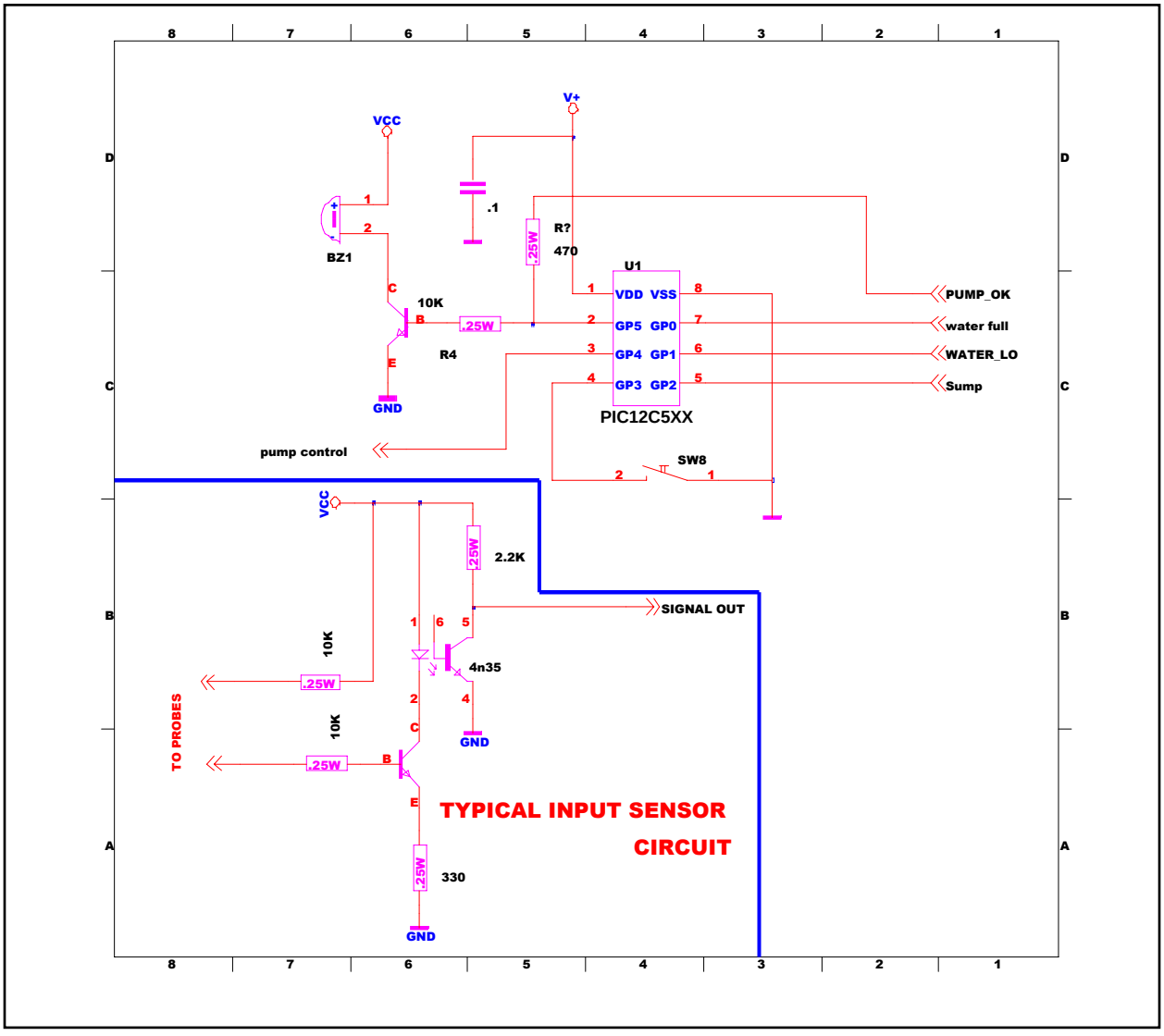
The flow chart is rather lengthy and is not given here. The program constantly monitors all the input conditions and updates a status word in memory. If any input condition is changed, the program checks and detects if there is any malfunction. If any defects are detected, the controller sounds an alarm. If the MCU detects the need for pumping, the pump is started and checks again for the water delivered to the discharge pipe. A sensor attached to the outlet does the job. This sensor o/p goes low when the water is pumping. If the

pump is not pumping water for a period set in the program, the pump is stopped and an alarm is given. If the pumping is ok, the program checks for the other inputs to find out if the low water indication goes off after some time of pumping and again checks for time-out for pump or water full input to trip the motor.

Warning and annunciation are also provided as an audible alert to the user. Different types of interruptions are given to the audio beep produced by the buzzer, so that the status of this controller can be monitored. The beep interrupt pattern (1s and Zeros - 1 causes beep and zero no beep) can be transferred to the code register before calling the beep routine. Each beep is for a duration of 0.6 seconds and can also be varied by changing the tmr2 value.

Note: Only one error code is written in the program. This error code gives a beep pattern, (beep beep beep beep).

CIRCUIT DIAGRAM OF PUMP CONTROLLER



APPENDIX A: SOURCE CODE

```
;-----------------------------------------------------
;This program runs on PIC12C5XX
;This program is written as control program
;for domestic pump controller
;WRITTEN BY MANI.T.K(VU2ITI)
;;-----------------------------------------------------
         LIST

         IFNDEF __12C508
           MESSG "Processor-header file mismatch.  Verify selected processor."
         ENDIF

;=============================================================
;
;        Register Definitions
;
;=============================================================

W               EQU        H'0000'
F               EQU        H'0001'

;----- Register Files --------------------------------------------------

INDF           EQU          H'0000'
TMR0           EQU          H'0001'
PCL            EQU          H'0002'
STATUS         EQU          H'0003'
FSR            EQU          H'0004'
OSCCAL         EQU          H'0005'
GPIO           EQU          H'0006'
register       equ          0x07
TMR1           equ          register+0
TMR2           equ          register+1
CODE           equ          register+2
COUNTER        EQU          register+3
DELAY          EQU          register+4
TMR0           EQU          01
E1             EQU          0XAA
;----- STATUS Bits --------------------------------------------------------

GPWUF          EQU          H'0007'
PA0            EQU          H'0005'
NOT_TO         EQU          H'0004'
NOT_PD         EQU          H'0003'
Z              EQU          H'0002'
DC             EQU          H'0001'
C              EQU          H'0000'
WATER_FUL      EQU          H'0000'
WATER_LO       EQU          H'0001'
SUMP           EQU          H'0002'
PUMP_OK        EQU          H'0003'
MANUAL         EQU          H'0005'
ALARM          EQU          H'0005'
OUTPUT         EQU          H'0004'
;----- OPTION Bits --------------------------------------------------------

NOT_GPWU       EQU          H'0007'
NOT_GPPU       EQU          H'0006'
T0CS           EQU          H'0005'
T0SE           EQU          H'0004'
PSA            EQU          H'0003'
PS2            EQU          H'0002'
PS1            EQU          H'0001'
PS0            EQU          H'0000'
```

```
;*************************************************************
;
;     RAM Definition
;
;*************************************************************

      __MAXRAM H'1F'

;*************************************************************
;
;     Configuration Bits
;
;*************************************************************


_IntRC_OSC       EQU        H'0FFE'
                 LIST
;
                 org        0          ;start address 0
;
;**************Program STARTS FROM  here*************
START
            BCF          STATUS,GPWUF

            MOVLW        0X07              ;Initialize the prescaler
            OPTION
            MOVLW        0X02F             ; initialize I/O lines. Only gp4 as output
            TRIS         GPIO              ; configure the input and output
            MOVF         GPIO,W            ;
            ANDLW        0X1F              ;Check for faulty inputs
            XORLW        0X02              ;
            BTFSC        STATUS,Z
            GOTO         ERROR1            ; input conditons are not ok, error bell
            BTFSS        GPIO,WATER_LO             ;CHECK FOR LOW WATER LEVEL
            GOTO         PUMP_START
            BTFSS        GPIO,MANUAL       ;Check if manual key pressed
            GOTO         MANUAL_MODE
            BTFSS        GPIO,SUMP         ;Check Water in sump is low
            GOTO         ERROR2                    ;Error. No water in sump
            SLEEP
PUMP_START
            BTFSS        GPIO,SUMP         ;verify if water in sump
            GOTO         START_PUMP
            GOTO         ERROR2                    ;Error, No water in sump
START_PUMP
            BSF          GPIO,OUTPUT       ;start pump
            MOVLW        0X01                      ;initialize timer0
            MOVWF        TMR0
            MOVLW        0XFF                      ;Pump START  test time(APP 16 SEC)
            MOVWF        TMR1                      ; TO the TIMER1
            MOVLW        0XFF                      ;Pump running  time(APP 1 HOUR)
            MOVWF        TMR2                      ; TO the TIMER2
LOOP
            MOVF         TMR0,F
            BTFSC        GPIO,SUMP         ;check for water in sump
            GOTO         ERROR2
            BTFSS        GPIO,MANUAL       ;check if manual button is pressed
            GOTO         MANUAL_MODE
            BTFSC        STATUS,Z          ;Check for 0.065 sec timer
            GOTO         LOOP
            DECFSZ       TMR1,F                    ;Check for timeout 0f 16.56 sec
            GOTO         LOOP
            BTFSC        GPIO,PUMP_OK
            DECFSZ       TMR2,F
            GOTO         CHECK

STOP_PUMP
```

```
                BCF             GPIO,OUTPUT     ;Switch off pump
                GOTO            ERROR3                  ;Pump timout error
CHECK
                BTFSC           GPIO,WATER_FUL          ;CHECK FOR WATER FILLED
                GOTO            LOOP
                BCF             GPIO,OUTPUT
                GOTO            START


; ************manual mode************
MANUAL_MODE
                BTFSS           GPIO,OUTPUT     ;Check if pump is running
                GOTO            START_PUMP      ; If not start pump
                GOTO            STOP_PUMP       ;or stop pump

;************ error routines*********************
ERROR1
                MOVLW           E1              ;take Error code
                MOVWF           CODE            ; now code contains the beep interrupt pattern
                CALL BEEP
                SLEEP
ERROR2
                ;
                ;
                SLEEP
ERROR3
                ;
                ;
                SLEEP
; error2, error3 etc can be similarly written
;;*****************************************
; subroutine Beep. This routine ouptuts a beep pattern
;    corresponds to the 1s in the code register
BEEP
                OPTION
                MOVLW           0X00F           ; initialize I/O lines.  GP4 AND GP5 as output
                TRIS            GPIO
                MOVLW           0X0A
                MOVWF           TMR1
                MOVLW           0X07
                MOVWF           COUNTER
REPEAT1
                RLF             CODE,F
                DECF            COUNTER
                BTFSS           STATUS,C
                GOTO            REPEAT1         ;Repeat until start of pattern (starts with first 1)

REPEAT2
                BSF             GPIO,ALARM
                MOVF            TMR0,F
                BTFSS           STATUS,Z
                GOTO            CHECK
                DECFSZ          TMR1,F
                GOTO            REPEAT2
                DECFSZ          COUNTER,1       ; if finished, return
                RETLW           0X00
                MOVLW           0X0A
                MOVWF           TMR1
                RLF             CODE,F
                BTFSS           STATUS,C
                GOTO            RSET
                GOTO            REPEAT2
RSET
                BCF             GPIO,ALARM
                GOTO            REPEAT2
                END
```