

CHAPTER 2

LITERATURE REVIEW

1.6 Sensor Section

Sensor or transducers is define as a device that receives energy from one system and transmit it to another, like physical variable into signal variable. Broadly defined, the sensor is a device which capable of being actuated by energising input from one or more transmission media and in turn generating a related signals to one or more transmission systems. It provides a usable output in response to specified input measured, which may be physical or mechanical quantity, property, or conditions. The energy transmitted by these systems may be electrical, mechanical or acoustical. The nature of electrical output from the transducers depends on the basic principle involved in the design. The output may be analog, digital or frequency modulated [2].

2.1.1 Selecting A Sensor

The sensor has to be physically compatible with its intended applications. There have eights specification that should be considered while selecting a sensor [2].

- 1) Operating range: Chosen to maintain range requirements and good resolution.
- 2) Sensitivity: Chosen to allow sufficient output.

- 3) Frequency response and resonant frequency: Flat over the entire desired range.
- 4) Environment compatibility: Temperature range, corrosive fluids, pressure, shocks, interaction, size and mounting restrictions.
- 5) Minimum sensitivity: To expected stimulus, other than measured.
- 6) Accuracy: Repeatability and calibration errors as well as errors expected due to sensitivity to other stimuli.
- 7) Usage and ruggedness: Ruggedness, both of mechanical and electrical intensities versus size and weight.
- 8) Electrical parameters: Length and type of cable required, signal to noise ratio when combined with amplifiers, and frequency response limitations.

For this project, infrared sensor has been chosen. Basically infrared sensor has two part, light emitter and light detector. The infrared emitters and detectors can be easily used to sense the absence or presence of object by simply "looking" at them from the top.

From many type of infrared sensor, GP2D120 has been chosen. This sensor has special lenses which gave a shorter detection range. It takes a continuous distance reading and reports the distance as an analog voltage with a distance range of 4cm to 30cm. GP2D120 has 3-wire with power, ground and output voltage.

A pulse of infrared light is emitted by the emitter. This light travels out in the field of view and either hits an object or just keeps on going. In the case of no object, the light is never reflected and the reading shows no object. Figure 2.1 shows, if the light reflects off an object, it returns to the detector and creates a triangle between the point of reflection, the emitter, and the detector.

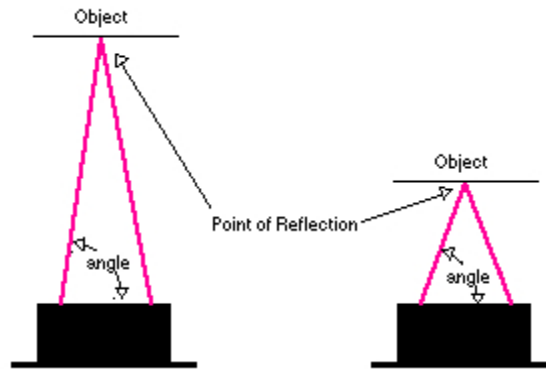


Figure 2.1: Different Angles with Different Distances

2.2 Data Conversion

By selecting the analog type of sensor, process of converting the output into digital have to consider. Analog data is generally acquired and converted into digital form for the purpose of processing, transmission, display and storage. Basically the data will be processing by processor.

An analog-to-digital converter (abbreviated ADC, A/D or A to D) is an electronic circuit that converts continuous signals to discrete digital numbers. The reverse operation is performed by a digital-to-analog converter (DAC).

Typically, an ADC is an electronic device that converts an input analog voltage to a digital number. The digital output may be using different coding schemes, such as binary and two's complement binary. However, some non-electronic or only partially electronic devices, such as rotary encoders, can also be considered as ADCs.

The usual method of bringing analog inputs into a microcontroller is to use an analog-to-digital converter (ADC). An ADC accepts an analog inputs, voltage or current, and converts it to a digital value that can be read by microprocessor. To avoid complication

in this circuit, a commercial single-chip ADC0804 is used to convert the analog signal to digital signal.

It works with +5V and has a resolutions. Conversion time is another major factor in judging an ADC. Conversion time is defined as the time it takes the ADC to convert the analog input to a digital (binary) number. In the ADC0804, the conversion time varies depending on the clocking signals applied to the CLK R and CLK IN pins, but it cannot be faster than 110ms. The pin configuration is explained in Figure 2.2

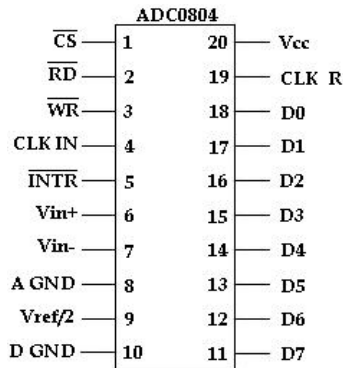


Figure 2.2: ADC0804 IC

\overline{CS} (Chip select)

This pin has to be low input to activate the ADC0804 chip.

\overline{RD} (Read)

This is an input signal and active low. The ADC converts the analog input to its binary equivalent and holds it in an internal register. RD is used to get the converted data out of the ADC0804 chip. When CS=0, if a high-to-low pulse is applied to the RD pin, the 8 bit digital output shows up at the D0-D7 data pins. The RD pin is also referred to as output enable.

\overline{WR} (Write)

This is an active low input used to inform the ADC0804 to start the conversion process. If $CS = 0$ when WR makes a low-to-high transition, the ADC0804 starts converting the analog input value of V_{in} to an 8-bit digital number. The amount of time it takes to convert varies depending on $CLK\ IN$ and $CLK\ R$ values explained below. When the data conversion is complete, the $INTR$ pin is forced low by the ADC0804.

CLK IN & CLK R

$CLK\ IN$ is an input pin connected to an external clock source when an external clock is used for timing. However, the 0804 has an internal clock generator. To use the internal clock (also called self clocking) of the ADC0804, the $CLK\ IN$ and $CLK\ R$ pins are connected to a capacitor and resistor. In that case the clock frequency is determined by equation:

$$F = 1 / 1.1 RC$$

Typically value are $R = 10k\Omega$ and $C = 150pF$. Substituting in the above equation, we get $f = 606kHz$. In that case, conversion time is $110\mu s$.

V_{in+} & V_{in-}

These are the differential analog inputs where $V_{in} = (V_{in+}) - (V_{in-})$. Often the $V_{in(-)}$ pin is connected to ground and the $V_{in(+)}$ pin is used as the analog input to be connected to digital.

V_{cc}

This is the +5 volt power supply. It also used as a reference voltage when the $V_{ref}/2$ input (pin 9) open (not connected).

$V_{ref}/2$

Pin 9 is an input voltage used for the reference voltage. If the pin is open (not connected), the analog input voltage for the ADC0804 is in the range of 0 to 5 volts (the same as the V_{cc} pin). However, there are many applications where the analog input applied to V_{in}

needs to be other than the 0-5 V. For example, if the analog input range needs to be 0-4 volts, $V_{ref}/2$ is connected to 2 volts.

Analog and Digital Ground

These are the input pins providing the ground for both the analog signal. The reason that we have two ground pins is to isolate the analog V_{in} signal from transient voltages caused by digital switching of the output D0-D7. Such isolation contributes to the accuracy of the digital data output.

D0-D7

D0-D7 (where D7 is the MSB, D0 the LSB) are the digital data output pins. These are tri-state buffered and the converted data is accessed only when $CS = 0$ and RD is forced low. To calculate the output voltage, use the following formula:

$$D_{out} = \frac{V_{in}}{\Delta}$$

Where D_{out} = digital data output (in decimal), V_{in} = analog input voltage, and step size or resolution, Δ is the smallest changes, which is $\Delta = \frac{2 * V_{ref}}{256}$ for an 8-bit ADC.

2.3 Control Section

A general purpose of processor provides the environment to run programs for the exploration. For this project the processor is working to control the motor pump, get data conversion from ADC and sent information to PC using software Visual Basic.

2.3.1 Microcontroller 8051 Basic Concept

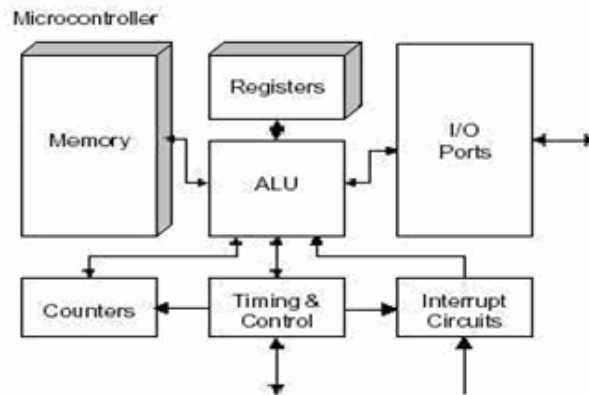


Figure 2.3: 8051 Microcontroller Architecture

Refer to Figure 2.3 for the microcontroller architecture; the microcontroller can perform arithmetic and logic function as defined in program. Only that the feature of a microcontroller chip is the inclusion, on a single chip, of all the resources which permits the IC to serve as a controller in a system or an instrument. From a basic 8051 microcontroller which use in this system, the main hardware is data RAM, Special Function Register, I/O port, UART, Programmable Timers and counters and external interrupt [3].

Microcontroller board are using to control the Water Monitoring System. This board is used to simulate data from sensor and make a decision to control the pump. Main

component for microcontroller board is the controller integrated circuit. For this board, it used AT89S52 microcontroller. This controller board has been chosen because it uses an assembly language that has been learned before. So, it will reduce a time to learn a new language.

2.3.2 Serial Communication

During a process to interface data from microcontroller on display window using Visual Basic, RS232 have to be used to communicate between each other.

The RS232 interface was developed for a single purpose, unambiguously stated by its title: “Interface between Data Terminal Equipment (DTE) and Data Communications Equipment (DCE) Employing Serial Binary Data Interchange.” Every word in the title is significant; it describes the interface between terminals (DTE) to a modem (DCE) for the transfer of serial data. The RS-232 specification allows for reliable data transmission from one transmitter to one receiver at data rates of up to 20K bits/second over relatively short distances (up to 50 feet). One more recent RS-232 transceiver chips, data rates of up to 1Mbps are achievable over shorter distances (up to 5 feet). The most common applications for RS-232 transceivers are computers and peripherals, mobile phone data cables and diagnostic data ports. This communication port is using to communicate with the PC for programming and also to display results on PC monitor. Figure 2.4 illustrates the RS-232 properties.

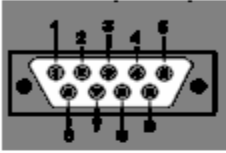
Pin No.	Name	Notes/Description
		
1	CD	Carrier Detect(CD) (from DCE) incoming signal from a modem
2	RD	Receive Data(RD) incoming Data from a DCE
3	TD	Transmitted Data (TD) Outgoing Data to a DCE
4	DTR	Data Terminal Ready (DTR) Outgoing handshaking signal
5	SGND	Signal Ground Common reference voltage
6	DSR	Data Set Ready(DSR) Incoming handshaking signal
7	RTS	Request To Send(RTS) Outgoing flow control signal
8	CTS	Clear To Send(CTS) Incoming flow control signal
9	RI	Ring Indicator(RI)(from DCE) Incoming signal from a modem

Figure 2.4: Descriptions pin for RS232

2.4 Water Pumping System

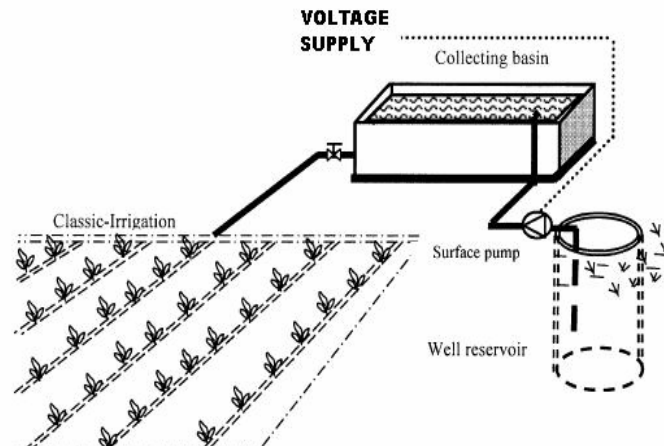


Figure 2.5: Water Pumping System Combined with a Classic Irrigation System [1].

Water pumps are designed to move water that does not contain suspended solids or particulates. Applications include water supply, irrigation, land and mine drainage, sea water desalination, and condensate transport.

Figure 2.5 gave the general view about the water monitoring system that will be design for this project. For that figure, the pumping system is using the classic irrigation system, there is no automatic controlling pump and automatic detect the level of water on the tank. It will be design to be more efficient system. The ac motor pump has been chosen to use and it will be control by microcontroller.