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AUTOMATION OF CHEMICAL WATER TREATMENT AND CONTROL

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***Abstract* — The purpose of all water treatment progression is to take away presented contaminants in the water, or decrease the concentration of such contaminants so the water becomes fit for its preferred end-use. One such employ is recurring water that has been used back into the natural environment lacking adverse ecological impact. The chemical water treatment is automatically controlled using the microcontroller. The process control algorithmic approach is used to computerize the plant process. This system involves the controlling of temperature of the collective tank where the mixture process takes place by using embedded program using AVR, by using this control the temperature of the collection tank by regulating the flow control of the tank. The temperature of the collective tank is measured by LM 35 using the AVR, if the temperature of the collective tank exceed, the flow of the inlet is regulated by rotating the valve of the tap using DC motor. This system presents a fully automated solution for controlling chemical water treatment plant process.**

Key Words* — *AVR microcontroller, Flow control, LM35 Temperature Sensor, Motor Open Valve, Temperature Control

1 INTRODUCTION

In the present advanced & modernized industrial world almost all the manufacturing & chemical industries have waste water with harmful chemicals as its ingredients as waste. Thus it becomes necessary to treat this water so as to reduce the harmful effluents from it and to make it suitable to be used for further industrial and agricultural applications.

The labor-intensive chemical water treatment plants which are used nowadays are manually operated and need to be automated so as to reduce the toxicity of chemicals and also to save a large amount of time and money.

The paper proposes an advanced process control algorithmic approach to computerize the plant processes.

These controllers are designed and simulated in real time proteus to control the flow rate of water and temperature of the plant including boiler and cooling water. The full plant is revolutionized with reliable & tested process control strategies leading to computerization of the system and will lead to high increase in efficiency of plant. Also, the health vulnerability will be abridged and lot of man-power and time will be saved.

1.1 WATER TREATMENT

Sewage treatment, or **domestic wastewater treatment**, is the process of removing contaminants from wastewater and household sewage, both runoff (effluents) and domestic. It includes physical, chemical, and biological processes to remove physical, chemical and biological contaminants. Its objective is to produce an environmentally-safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse (usually as farm fertilizer)

Chemical treatment is still an essential component in many water and wastewater treatment schemes. The general purposes of the chemical treatment are: removal of suspended solids (turbidity) from the water; pH adjustment; removal dissolve material in the water; improve water quality.

The Basic of Chemical Treatment

- pH adjustments and control
- Coagulation / Flocculation
- Precipitation
- Clarification

1.2 WATER TREATMENT CHEMICALS

For the chemical treatment of water a great variety of chemicals can be applied. Below, the different types of water treatment chemicals are such as, Algaecides, Antifoams, Biocides, Boiler water Chemicals, Coagulants, Corrosion inhibitors, Disinfectants, Flocculants, Neutralizing agents, Oxidants, Scale inhibitors and pH conditioners

1.3 THE NEED FOR WATER TREATMENT

Water treatment is the process that water goes through so that it can be of better quality to be used. It is made to be safer for humans to drink and for industries to use with a small to none environmental problem.

The water treatment method will vary greatly. This article will inform you of two of the major kinds of water treatment. They are water purification and treatment of sewage.

1.4 ADVANTAGES OF PURIFICATION OF WATER

The whole point behind purifying water is that this water treatment method cleans out any contaminants in the water. The water that comes from this process is clean and safe enough for you to drink and for using in industry.

Hard water contains high levels of dissolved minerals, According to the Water Quality and Health Council, prior to the use of chlorinated drinking water at the turn of the century, waterborne diseases such as cholera, typhoid fever, dysentery and hepatitis claimed thousands of U.S. lives each

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year. Today, chlorination is still the most common disinfection method for public drinking water and swimming pools. Not only does chlorination help prevent the spread of infections such as E. coli, it also destroys bacteria, algae and mold that can grow on the walls of water storage systems, and it removes unpleasant tastes and odors from drinking water. While chlorination is effective at sanitizing drinking water, it can be difficult to handle without expertise and experience. The chlorination of water used for showering, laundering and swimming can dry out the skin and hair, may cause eye irritation and can also fade which can build up in water pipes and internal systems to cause obstruction and permanent damage. Water softeners made with hydrated lime can treat water quality to improve hard water and also reduce the levels of toxic arsenic in drinking water. Lime also alters the water pH and works to destroy the environment required for the growth of bacteria and viruses. In some cases, the pH levels become too high with lime softening. When lime is added to chlorinated water, the resulting formation of hypochlorite is a disinfectant that's inferior to other free chlorine residuals.

2. EXISTING SYSTEM

Treatment of high strength waste is the foundation of Pharmer Engineering. We provide services for numerous food processors including Bush Brothers, J.R. Simplot, Kraft, Glanbia and Basic American Foods.

Pharmer Engineering works with the industry to determine the treatment option that is best suited for the application. We provide general design, and build services, or we often implement the improvement through a design build team.

We understand the schedule and budgetary demands of the private sector and work with the client to provide the best engineering value for their requirements in an expedited manner.

Industrial Experience Examples of past industrial projects performed or led by Pharmer's water and wastewater professionals. The projects are divided into the following areas:

- Food and Beverage
- Meat Products
- Dairy Products
- Canned, Frozen and Preserved Fruits and Vegetables
- Grain Mill Products
- Sugar and Confectionery Products
- Miscellaneous Food Preparations and Kindred
- Multiple-Client Projects
- Chemical/Metals

2.1 HYDE MARINE BALLAST SYSTEM-PRATICAL SOLUTION FOR BALLAST WATER

Around the world more than 10 billion tons of ballast water is carried in ships each year containing thousands of species of aquatic animals and plants. This creates problems for the marine environment and human health and threatens economies that depend on healthy aquatic ecosystems. The transportation of ballast water cannot be stopped, but the transfer of harmful aquatic organisms and pathogens can be minimized by deep sea exchange or suitable treatment. Ballast water exchange is costly, time consuming and is at best only 90% effective. Pumps may have to run for 3-4 days, which increases fuel consumption, and wear and tear on equipment and stack emissions. Ballast water exchange can result in increased hull stresses and stability problems.

The principal objective of wastewater treatment is generally to allow human and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment. Irrigation with wastewater is both disposal and utilization and indeed is an effective form of wastewater disposal (as in slow-rate land treatment). However, some degree of treatment must normally be provided to raw municipal wastewater before it can be used for agricultural or landscape irrigation or for aquaculture. The quality of treated effluent used in agriculture has a great influence on the operation and performance of the wastewater-soil-plant or aquaculture system. In the case of irrigation, the required quality of effluent will depend on the crop or crops to be irrigated, the soil conditions and the system of effluent distribution adopted. Through crop restriction and selection of irrigation systems which minimize health risk, the degree of pre-application wastewater treatment can be reduced. A similar approach is not feasible in aquaculture systems and more reliance will have to be placed on control through wastewater treatment.

The most appropriate wastewater treatment to be applied before effluent use in agriculture is that which will produce an effluent meeting the recommended microbiological and chemical quality guidelines both at low cost and with minimal operational and maintenance requirements (Arar 1988). Adopting as low a level of treatment as possible is especially desirable in developing countries, not only from the point of view of cost but also in acknowledgement of the difficulty of operating complex systems reliably. In many locations it will be better to design the reuse system to accept a low-grade of effluent rather than to rely on advanced treatment processes producing a reclaimed effluent which continuously meets a stringent quality standard.

2.1.1 Solid Chemicals for Cooling Towers, Boilers & Closed Loops

Eliminate the need to transport dilute water based chemicals, lift heavy drums, and deal with hazardous liquid spills and dispose of used drums. Technically advanced chemical products manufactured in a unique, highly concentrated solid form utilizing proven, state of the art chemical technologies to offer significant operational, safety and environmental benefits

2.1.2 CIP Cooling Tower Pack Cleaning Range

Accepta’s innovative range of advanced cooling tower cleaners are based on the use of a unique foaming chlorine dioxide system and have been developed to offer a practical alternative to pack removal in the UK HSE's ACoP L8 tower cleaning procedures

2.1.3 *Hydrogen Peroxide, Silver Disinfectant*

Accepta 8101 is an advanced; eco-friendly multi-component disinfectant formulated using hydrogen peroxide synergized with colloidal silver and in the UK is approved under Regulation 31 of the Water Supply (Water Quality) Regulations 2000 for use as an emergency disinfectant for potable water supplies. Used as a hard surface cleaner or water additive for the effective control of biofilm and waterborne micro-pathogens including Legionella bacteria, E.coli, Pseudomonas, Salmonella, MRSA, VRE and other bacterial, viral and fungal infections

2.1.4 *Stabilized Bromine Biocide*

Accepta 2578, a high performance stabilized bromine biocide is excellent for the removal of microbiological growth and biofilm. A single-component stabilized liquid bromine solution Accepta 2578 incorporates an in-built stabilizer to reduce volatility, keeping most products available in the system for microbial control

3 PROPOSED SYSTEM

The chemical water treatment is automatically controlled using the microcontroller. The process control algorithmic approach is used to computerize the plant process.

This system involves the controlling of temperature of the collective tank where the mixture process takes place by using embedded program using AVR, by using this control the temperature of the collection tank by regulating the flow control of the tank

The temperature of the collective tank is measured by LM 35 using the AVR, if the temperature of the collective tank exceed, the flow of the inlet is regulated by rotating the valve of the tap using DC motor.

The flow of effluent tank is controlled tank is using MOV (motor open valve) is varying the supply voltage to the motor, then that the speed of the motor is varied.

The temperature of the tank is also maintained by regulating the flow of the effluent and flow of the wastewater.

This system presents a fully automated solution for controlling chemical water treatment plant process.

3.1 PROCESS DIAGRAM

In the present advanced and modernized industrial world almost all the manufacturing & chemical industries have waste water with harmful chemicals as its ingredients as waste. Thus it becomes necessary to treat this water so as to reduce the harmful effluents from it and to make it suitable to be used for further industrial and agricultural applications. The labor-intensive chemical water treatment plants which are used nowadays are manually operated and need to be automated so as to reduce the toxicity of chemicals and also to save a large amount of time and money. This project proposes an advanced process control algorithmic approach to computerize the plant processes.

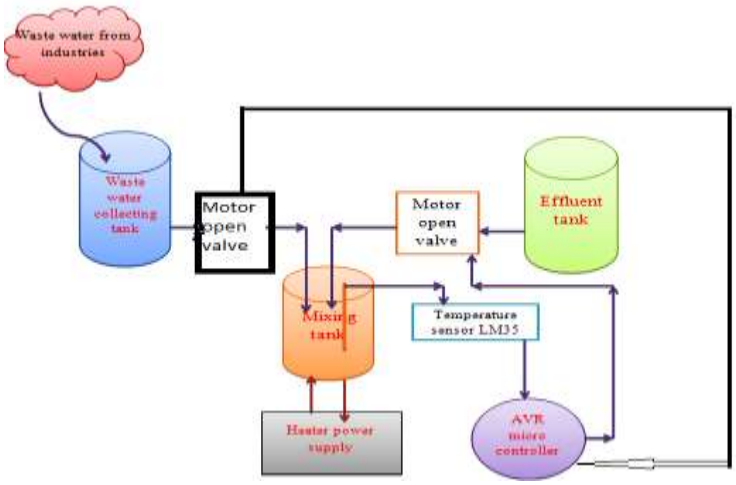

Fig 1: Process diagram

These controllers are designed and simulated in real time proteus to control the flow rate of water and temperature of the plant including boiler and cooling water. The full plant is revolutionized with reliable & tested process control strategies leading to computerization of the system and will lead to high increase in efficiency of plant. Also, the health vulnerability will be abridged and lot of man-power and time will be saved.

3.2 HARDWARE DESCRIPTION

3.2.1 *Microcontroller*

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, office machines and other embedded systems. By reducing the size and cost, microcontrollers make it economical to digitally control even more devices and processes.

3.2.1.1 *AVR microcontroller*

The **AVR** is a modified Harvard architecture 8-bit RISC single chip microcontroller which was developed by Atmel in 1996. Atmel's AVRs have a two stage, single level pipeline design. This means the next machine instruction is fetched as the current one is executing. Most instructions take just one or two clock cycles, making AVRs relatively fast among the eight-bit microcontrollers. The AVR family of processors was designed with the efficient execution of compiled C code.

3.2.1.2 *Features*

The AVR microcontroller offers excellent features which makes programmer to build the Application effectively. Some of the features are:

- In-built 8 Channel muxed 10 bit ADC
- Excellent operating Speed
- Fast PWM generator
- 8 bit and 16 bit Timers and Counters
- USART
- Two Wire Interface
- Watchdog Timer

3.2.1.3 *Architecture of AVR microcontroller*

The Atmel Corporation has a wide selection of Atmega chips. It is popular and inexpensive chip used in many small projects. The AVR enhanced RISC

microcontroller are based on a new RISC architecture that has been developed to take advantage of semiconductor integration and software capabilities of the 1990's. The memory sizes and peripherals indicated in the figure are for the AT90S8414 microcontroller.

Central in the AVR architecture is the fast-access RISC register file, which consists of 32 x 8-bit general purpose working registers. Within one single clock cycle, AVR can feed two arbitrary registers from the register file to the ALU, do a requested operation, and write back the result to an arbitrary register. The ALU supports arithmetic and logic functions between registers or between a register and a constant. Single register operations are also executed in the ALU.

As can be seen from the figure, AVR uses a Harvard architecture, where the program memory space is separated from the data memory space. Program memory is accessed with a single level pipelining. While one instruction is being executed, the next instruction is being pre-fetched from the program memory.

Due to the true single cycle execution of arithmetic and logic operations, the AVR

Microcontrollers achieve performance approaching 1 MIPS per MHz allowing the System designer to optimize power consumption versus processing speed.

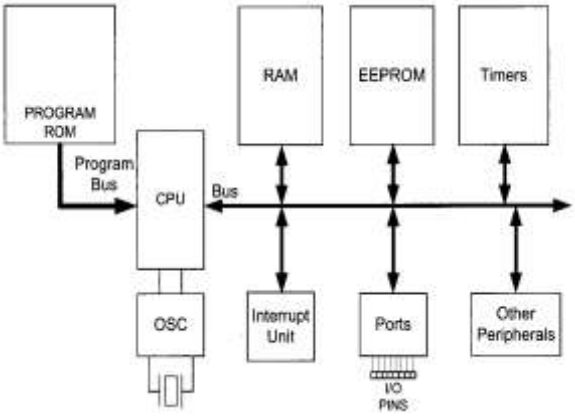

Fig 2: Architecture of AVR

The **AVR** is a modified Harvard architecture 8-bit RISC single chip microcontroller which was developed by Atmel in 1996. Atmel's AVRs have a two stage, single level pipeline design. This means the next machine instruction is fetched as the current one is executing. Most instructions take just one or two clock cycles, making AVRs relatively fast among the eight-bit microcontrollers. The AVR family of processors was designed with the efficient execution of compiled C code.

3.2.2 DC Motor

DC motors are at all times preferred over stepper motors while it comes to speed, weight, size and cost. There are a lot of things which we can do with our DC motor while interfaced with a microcontroller. For example we can control the speed of motor, we can control the direction of rotation, we can also do encoding of the rotation made by DC motor i.e. keeping track of how many turns are made by our motors etc. So DC motors are preferred over servo motors.

3.2.2.1 **L293D Dual H-Bridge Motor Driver**

L293D is a dual H-Bridge motor driver, so with one IC we can interface two DC motors which can be controlled in both clockwise and counter clockwise directions and if we have motor with fix direction of motion then we can make use of all the four I/Os to connect up to four DC motors.
An H-bridge is an arrangement of transistors that allows a circuit full control over a standard electric DC motor. The schematic representation of an H- Bridge circuit is shown in figure 4.5. With an H-bridge a microcontroller, logic chip, or remote control can electronically command the motor to go forward, reverse, brake, and coast.

3.2.2.2 **Features of L293D**

- L293D has output current of 600mA
- Peak output current of 1.2A per channel
- Moreover for protection of circuit from back EMP output diodes are included within the IC
- The output supply (Vcc2) has a wide range from 4.5V to 36V. This has made L293D a best choice for DC motor driver. A simple schematic for interfacing a DC motor using L293D is shown below

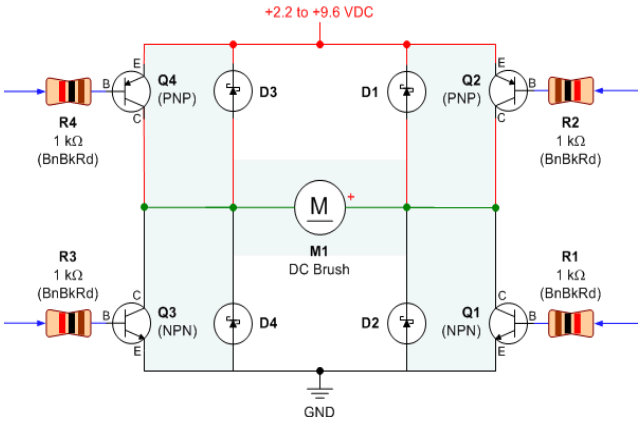

Fig 3: DC Motor Interface with L293D

A	B	Description
0	0	Motor Stops or breaks
0	1	Motor runs anti-clockwise
1	0	Motor runs clockwise
1	1	Motor stops or breaks

Table 1: Truth table of L293D
For above truth table, the enable has set to 1.

Similar is true for another motor connected to Out3 and Out4 of L293d and can be controlled through IN3 and IN4. This is all about controlling the direction of DC motor using L293d and ATmega32. To control the speed of DC motor one can use a Pulse Width Modulated signal on Enable1 and Enable2 pins of L293D, this will result in controlled power input on motor, so speed is controlled.

3.2.2.3 Speed Control of DC Motor

Pulse-width modulation is an effective method for adjusting the amount of power delivered to an electrical load. PWM is used in many industrial applications mostly for controlling the motor speed. AVR microcontroller has an

inbuilt PWM generator which can be programmed to generate PWM signal with various frequency ranges of 60Hz, 150 Hz, and 300 Hz etc. The width of the Pulse can be varied by the value in the comparator register of the respective timer which is from 0 to 255. The AVR microcontroller has 4 PWM generators which can be programmed independently for controlling various applications. The PWM signal which changes the DC motor speed is showed on the following PWM signal timing diagram shown in the Fig 4.

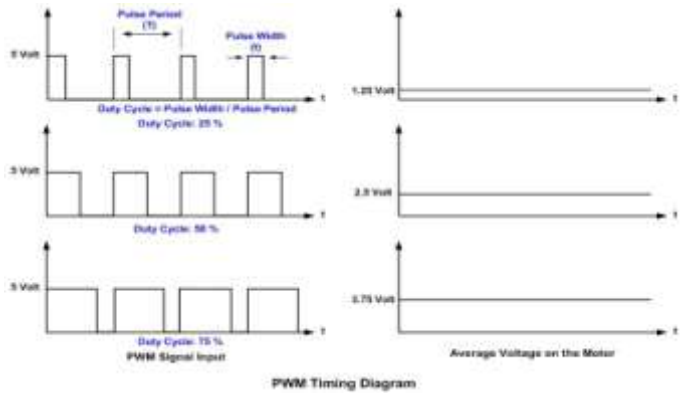

Fig 4: Pulse Width Modulation

From the PWM timing diagram above, we could see that by changing the pulse width we could change the average voltage received by the DC motor. Wider is the pulse width, higher is the average voltage received by the DC motor. Shorter is the pulse width, lower is the average voltage received by the DC motor. Therefore by varying the pulse width we could vary the DC motor speed. The ratio between the pulse width and the total length of the pulse (time on plus time off) is called duty cycle, so by saying 100% duty cycle means the DC motor is in its full speed and 10% duty cycle the DC motor is in its 10% of speed.

3.2.3 SENSOR

3.2.3.1 Temperature Sensor LM 35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55° to +150°C temperature range, while the LM35C is rated for a -40° to +110°C range (-10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

3.2.3.2 Features

- Calibrated directly in ° Celsius (Centigrade).
- Linear + 10.0 mV/°C scale factor.
- 0.5°C accuracy guarantee able (at +25°C).
- Rated for full -55° to +150°C range.
- Suitable for remote applications.
- Low cost payable to wafer-level trimming.
- Operates from 4 to 30 volts.
- Less than 60 µA current drain.
- Low self-heating, 0.08°C in still air.
- Non-linearity just ±¼°C typical.
- Low impedance output, 0.1 Ohm for 1 mA load

3.2.3.3 Use of LM35 to Measure Temperature

You can assess temperature more accurately than a using a thermistor. The sensor circuitry is preserved and not subject to oxidation, etc.

The LM35 generates a higher output voltage than thermocouples and might not need that the output voltage be improved.

Fig 5: LM35

3.2.3.4 **Working of LM35**

- It has an output voltage that is proportional to the Celsius temperature.
- The scale factor is .01V/ºC
- The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 ºC at room temperature and +/-0.8 ºC over a range of 0 ˚C to +100 ˚C.
- Another important characteristic of the LM35DZ is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1 ºC temperature rise in still air.

The LM35 comes in many different packages, including the following.

- TO-92 plastic transistor-like package,
- T0-46 metal can transistor-like package
- 8-lead surface mount SO-8 small outline package

3.2.3.5 Outputs from LM35

You will need to use a voltmeter to sense Vout.

- The output voltage is converted to temperature by a simple conversion factor.
- The sensor has a sensitivity of 10mV / ºC.
- Use a conversion factor that is the reciprocal that is 100V / ºC.

The general equation used to convert output voltage to temperature is:

- Temperature (ºC) = Vout * (100 ºC/V)
- So if Vout is 1V , then, Temperature = 100 ºC
- The output voltage varies linearly with temperature.

3.2.3.6 Sensor Output (LM 35)

Temperature (°C)	Voltage (V)
33	0.30
34	0.31
40	0.37
50	0.47
60	0.57
70	0.67
80	0.77
90	0.87
95	0.92

Table 2: Sensor output

3.2.4 Relay Overview

A relay is a switch which operates electrically. When a current is passed through the coil of the relay, it creates a magnetic field that attracts a lever and alters the switch contacts. The current that flows in the coil can be ON or OFF so relays have two switch arrangements and hence they are called as double throw (changeover) switches.

Relays permit one circuit to switch a second circuit which can be completely divide from the first. For instance a low voltage battery circuit can employ a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay among the two circuits; the connection is magnetic and mechanical.

The coil of a relay exceeds a moderately large current, normally 30mA for a 12V relay, but it is able to be as much as 100mA for relays designed to function from lower voltages. Most ICs (chips) cannot offer this current and a transistor is typically used to increase the small IC current to the larger rate necessary for the relay coil. The highest output current for the popular 555 timer IC is 200mA so these devices are able to deliver relay coils directly without amplification.

Relays are frequently SPDT or DPDT but they can have many additional sets of switch contacts, for instance relay with 4 sets of changeover contacts are willingly available. The majority relays are planned for PCB mounting except you can solder wires straight to the pins providing you take mind to avoid melting the plastic holder of the relay.

The supplier's catalogue is supposed to illustrate you the relay's link. The coil will be clear and it may be connected also way round. Relay coils make brief high voltage 'spikes' while they are switched off and this can tear down transistors and ICs in the circuit. To prevent harm you must attach a protection diode transversely the relay coil.

The connections of relay switches are usually contain COM, NC and NO.

COM = Common, for all time connect to this; it is the moving element of the switch.

NC = Normally Closed, COM is connected to this while the relay coil is off.

NO = Normally Open, COM is connected to this while the relay coil is on.

Connect to COM and NO if you want the switched circuit to be on when the relay coil is on.

Connect to COM and NC if you want the switched circuit to be on when the relay coil is off.

Most relays are SPDT or DPDT which are often described as "single pole changeover" (SPCO)

Or "double pole changeover"(DPCO).

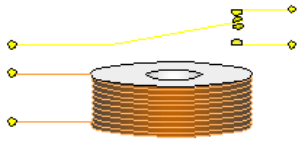

Fig 6: SPDT

This is a Single Pole Double Throw relay. Current will run among the movable contact and one fixed contact when the coil is energized and along with the movable contact and the alternate fixed contact when the relay coil is energized. The majority normally used relay in car audio, the Bosch relay, is a SPDT relay.

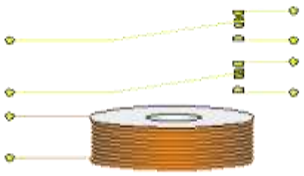

Fig 7: DPDT

This relay is a Double Pole Double Throw relay. It operates similar to the SPDT relay except has twice as many contacts. There are two totally lonely sets of contacts.

3.2.4.1 Relay Construction

Relays are wonderfully trouble-free devices. There are four parts in each relay:

- Electromagnet
- Armature that can be attracted by the electromagnet
- Spring
- Set of electrical contacts

A relay consists of two separate and totally autonomous circuits. The first is at the bottom and drives the electromagnet. In this circuit, a switch is calculating power to the electromagnet. When the switch is on, the electromagnet is on, and it attract the armature. The armature is performing

as a switch in the second circuit. When the electromagnet is energized, the armature completes the second circuit and the light is on. When the electromagnet is not energized, the spring pulls the armature away and the circuit is not full. In that case, the light is dark.

When you buy relays, you generally have control over more than a few variables:

- The voltage and current that is desired to make active the armature.
- The number of armatures (normally one or two).
- The number of contacts for the armature (generally one or two -- the relay exposed here has two, one of which is unused).
- Whether the contact (if only one contact is provided) is **n**ormally **o**pen (**NO**) or **n**ormally **c**losed (**NC**).

3.2.4.2 Relay Applications

In common, the position of a relay is to use a small amount of power in the electromagnet coming, say, from a small dashboard switch or a low-power electronic circuit -- to shift an armature that is capable to switch a much larger sum of power. For example, you might wish for the electromagnet to energize using 5 volts and 50 milliamps (250 mill watts), even as the armature can support 120V AC at 2 amps (240 watts). Relays are fairly common in home appliances where there is an electronic control turning on something like a motor or a light. They are also common in cars, where the 12V supply voltage means that just about everything needs a large amount of current. In later model cars, manufacturers have started combining relay panels into the fuse box to make maintenance easier.

In places where a large amount of power needs to be switched, relays are frequently cascaded. In this case, a small relay switches the power needed to drive a much larger relay, and that second relay switches the power to drive the load. Relays can also be used to implement Boolean logic.

3.2.4.3 Advantages of Relay

- Can switch **AC** and **DC**, whereas the transistors are able to merely switch DC.
- Can switch **high voltages,** but transistors cannot switch.
- They are an improved option for switching **large currents** (> 5A).
- Can switch **many contacts** at one time.

4. RESULT AND CONCLUSION

The chemical water treatment plant was completely controlled automatically, by using the AVR microcontroller. In that process, the flow of the effulent is diverse due to the variation of the temperature in the mixing tank, the flow of the effulent is varied by using the motor open valve.

And the temperature of the mixing tank is also maintained in the corresponding temperature by using the temperature sensor LM35 using the AVR controller.

The total automatic process is restricted by using the embedded programming used in the AVR. And also problem present in the system is abolished.

Fig 8: Hardware Model of the Proposed System

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Mr. P. Alexander M.E., Assistant Professor in the Dept. of ICE, at Sri Manakula Vinayagar Engineering College, Puducherry, India. He has a teaching experience of 5 years. He has published papers in two International Journals and one National Conference. He is interested in the areas like Virtual Instrumentation and Industrial Instrumentation.