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Flash Flood Warning System Using Scada Systems

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Abstract:

Flash flood is one of the natural disasters thatcause severe damage in many parts around the world. The largenumbers of villager who reside along the stream side suffer bylosing their accommodations, properties, and life. The reasonthat made flash flood very dangerous is abruptly happening withno proper warning. The objective of this research is to develop a flash flood warning system that able to be installed in any interesting area. The warning system is designed to be able to work as a standalone sensor or as a group of remote sensor.The project aimed to develop activities, or innovations to help the communities to recover from flood and to be able to handle the future situation. In this system the software is implemented in a Codesys programming system, in order to show the success and the applicability of the method.CoDeSys is a complete development environment for your PLC. It stands for Controlled Development System.In this system we are using a PLC for performing logical operations to alert the system in such a way that people who are residing flood effected area can prepare to save their life and properties.

Key Words: PLC, SCADA, CoDeSys.

Introduction:

Flash floods can be dangerous and destructive in almost any part of the world. In Italy in June 1996, more than 40 cm (15.7 inches) of rain fell in less than six hours, pouring as much as 8.8 cm (3.5 inches) in 30 minutes, a near-record rate for Italy. The village of Cardoso in the Versilia Valley was severely damaged by the resulting flash flood. Thirteen people died. RecentfindingsoftheWMOcountry-levelsurveywhereofthe 139 countries, 105 indicated that flash floodswereamongthetop twomostimportanthazardsaround theworld and requirespecial attention.

Ontheaverage, theseeventskillmorepeopleworldwidethanany othernaturaldisasterinanaverageyear,flash floodskillover 5,000 unsuspectingpeopleand cause millionsofd ollarsofpropertydamage(WMO2008).More recently, flash floods swept through the town of AguasCalientas, Peru, in late January 2010, trapping 4,000 tourists on their way to or from the ruins of Machu Picchu.

They were stranded in the tiny town for two or more days before helicopters could carry them out. The swollen Urubamba (Valcanota) River washed away bridges and destroyed many sections of the railroad that takes tourists there. One rain gauge 100 km upstream recorded 23.6 cm in 13 hours prior to the floods. Authorities estimated the floods destroyed 2,000 homes.

The industrial control system SCADA (Supervisory Control and Data Acquisition) system is selected to work as a central control program of the warning system. The HMI (Human Machine Interface) is designed based on the contour map of the interest area. The laboratory results show that the system able to measure the level precisely and real-time. Due to lack of logical operations the system was unable to alert the situation in a practical way.

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Level Sensor:

Many types of level sensors were developed for different purposes. The level sensors can be categorized into two major types

•Point detection
•Continuous monitoring sensor.

The multi-point detection is good for the flood detection. The continuous monitoring system might not necessary because flood monitoring system does not need that high resolution. The conductive probe is considered as the first alternative for this research due to its durability and reliability.

Sensor Network:

Fig. The sensor module

To install the level sensors in the interested area that might cover multi-square kilometre. The wireless system is needed to be implemented. One of the important applications related to remote sensing is sensor network. The sensor network is applicable to various applications such as military, environmental application and agricultural . The sensor network was classified into three different categories:

•Internal platform and underlying operating system

•Communication protocol stack

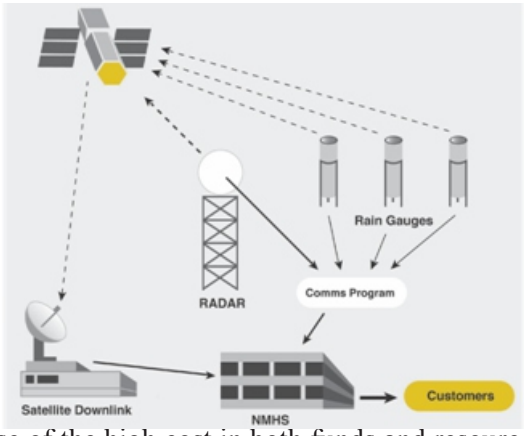
•Network services, provisioning, and deployment

However, the system with sensor network must be design under good understanding of computer networking. The flash flood warning system needs a rugged and stable equipment and algorithm. Then, the sophisticated sensor network system may not suitable for this application. The most appropriate sensor to be use because it is rugged and inexpensive. Figure I illustrate the simple four-level conductive probe level sensor. Each level sensor represent water level that are:

•Normal,
•Low-Mid,
•High-Mid,
•Evacuate.

Redundant data communications pathways:

Because of the high cost in both funds and resources and the high probability of encountering problems due to the infrequency of use, full back up should be used only as a last resort. A centre should strive to establish on- site redundancies in communications, hardware.



Because of the high cost in both funds and resources and the high probability of encountering problems due to the infrequency of use, full backup should be used only as a last resort. A centre should strive to establish on- site redundancies in communications, hardware and software so that it can continue to function in the event of a minor system outage. Hardware redundancy is an important requirement for a centre. This hardware redundancy goes hand in hand with the need for a centre to obtain redundant rainfall and stream flow data from several different networks via several different communications channels whenever feasible. Redundancy helps to ensure that the data for applications programs will be available when most needed: during an event. As an added bonus, the backup system can also be configured as a training tool.

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Ladder Logic:

The language itself can be seen as a set of connections between logical checkers (contacts) and actuators (coils). If a path can be traced between the left side of the rung and the output, through asserted (true or "closed") contacts, the rung is true and the output coil storage bit is asserted (1) or true. If no path can be traced, then the output is false (0) and the "coil" by analogy to electromechanical relays is considered "de-energized". The analogy between logical propositions and relay contact status is due to Claude Shannon.Ladder logic has contacts that make or break circuits to control coils. Each coil or contact corresponds to the status of a single bit in the programmable controller's memory. Unlike electromechanical relays, a ladder program can refer any number of times to the status of a single bit, equivalent to a relay with an indefinitely large number of contacts.

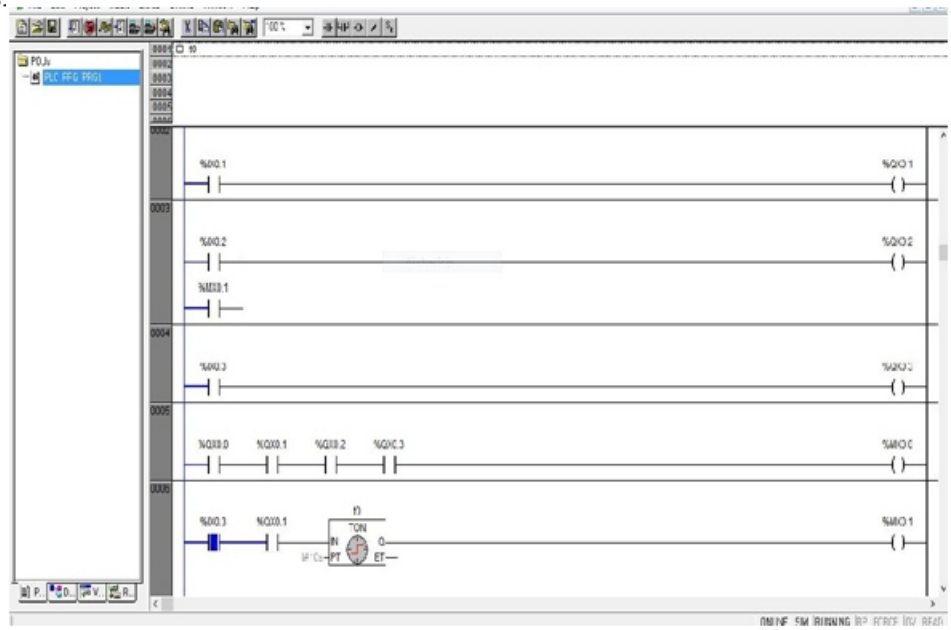
So-called "contacts" may refer to physical ("hard") inputs to the programmable controller from physical devices such as pushbuttons and limit switches via an integrated or external input module, or may represent the status of internal storage bits which may be generated elsewhere in the program. Each rung of ladder language typically has one coil at the far right. Some manufacturers may allow more than one output coil on a rung.

—( )— A regular coil, energized whenever its rung is closed.

—(\)— A "not" coil, energized whenever its rung is open.

—[ ]— A regular contact, closed whenever its corresponding coil or an input which controls it is energized.

—[\]— A "not" contact, closed whenever its corresponding coil or an input which controls it is not energized.



The "coil" (output of a rung) may represent a physical output which operates some device connected to the programmable controller, or may represent an internal storage bit for use elsewhere in the program.

Logical AND

------[ ]--------------[ ]----------------( )

Key Switch 1 Key Switch 2 Door Motor

The above realizes the function: Door Motor = Key Switch 1 AND Key Switch 2 This circuit shows two key switches that security guards might use to activate an electric motor on a bank vault door. When the normally open contacts of both switches close, electricity is able to flow to the motor which opens the door.

Logical AND with NOT

------[ ]--------------[\]----------------( )

Close Door Obstruction Door Motor

The above realizes the function: Door Motor = Close door AND NOT(Obstruction).

PRINCIPLES OF OPERATION:

A programmable controller consists of two basic sections:

•The central processing unit.

•The input/output interface system.

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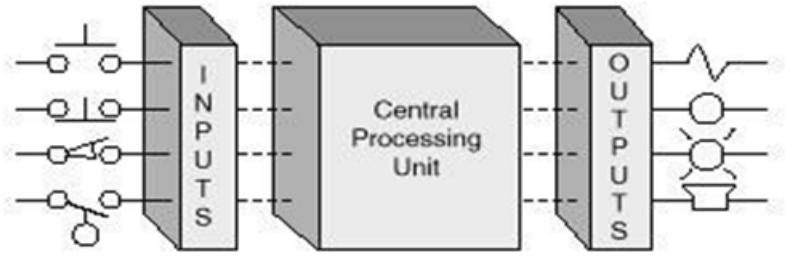

Figure Programmable Controller Block Diagram

The central processing unit (CPU) governs all PLC activities. The following three components which form the CPU:

- The processor
- The memory system
- The system power supply

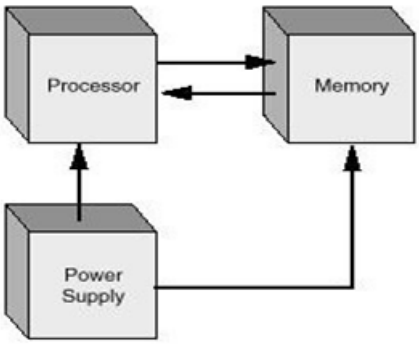

Figure Block Diagram of Major CPU Components

BRIEF DESCRIPTION OF PLC COMPONENTS:

INPUT / OUTPUT:

Incoming signals from sensors (e.g., push buttons, limit switches, analog sensors, selector switches, and thumbwheel switches) are wired to terminals on the input interfaces. Devices that will be controlled, like motor starters, solenoid valves, pilot lights, and position valves, are connected to the terminals of the output interfaces.

POWER SUPPLY:

The system power supply provides all the voltages required for the proper operation of the various central processing unit sections.

PROCESSOR:

The processor sequentially reads the inputs, execute the program in memory, and update the outputs.

MEMORY:

The memory is used to store the user program.

PROGRAMMING DEVICE:

Although not generally considered a part of the controller, the programming device, usually a personal computer or a manufacturer's mini programmer unit, is required to enter the control program into memory. The programming device must be connected to the controller when entering or monitoring the control program.

CODESYS:

CODESYS (an acronym for controllerdevelopment system, previously stylized CoDeSys) is a development environment for programming controller applications according to the international standard IEC 61131-3.

All five programming languages for application programming defined in the IEC 61131-3 are available in the CODESYS development environment.

•IL (Instruction list) is an assembler like programming language.

•ST (Structured text) is similar to programming in PASCAL or C.

•LD (Ladder diagram) enables the programmer to virtually combine relay contacts and coils

•FBD (Function block diagram) enables the user to rapidly program both Boolean and analogue expressions

•SFC (Sequential function chart) is convenient for programming sequential processes and flows

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VISUALISATION:

An integrated editor helps the user create complex visualization masks directly in the programming system CODESYS and animate them based on application variables. To simplify the procedure, integrated visualization elements are available. An optional toolkit enables the user to create his own visualization elements. The masks created are, among others, used for application tests and commissioning during online operation of the programming system. In combination with optional visualization clients, the masks can also be used to operate machines or plants, e. g. on controllers with integrated display, in web browsers or a portable runtime under windows or Linux. Introduction ToSCADA

SCADA (supervisory control and data acquisition) has been around as long as there have been control systems. The first 'SCADA' systems utilized data acquisition by means of panels of meters, lights and strip chart recorders.

The operator manually operating various control knobs exercised supervisory control. In modern manufacturing and industrial processes, mining industries, public and private utilities, leisure and security industries telemetry is often needed to connect equipment and systems separated by large distances. This can range from a few meters to thousands of kilometers.SCADA refers to the combination of telemetry and data acquisition. SCADA encompasses the collecting of the information, transferring it back to the central site, carrying out any necessary analysis and control and then displaying that information on a number of operator screens or displays.

Implementation of flash flood warning system using PLC&SCADA:

The programming for PLC is done on CoDeSys programming system, in order to show the success and ability of the method. CoDeSys is a complete development environment for your PLC. Coding in PLC programing CoDeSys

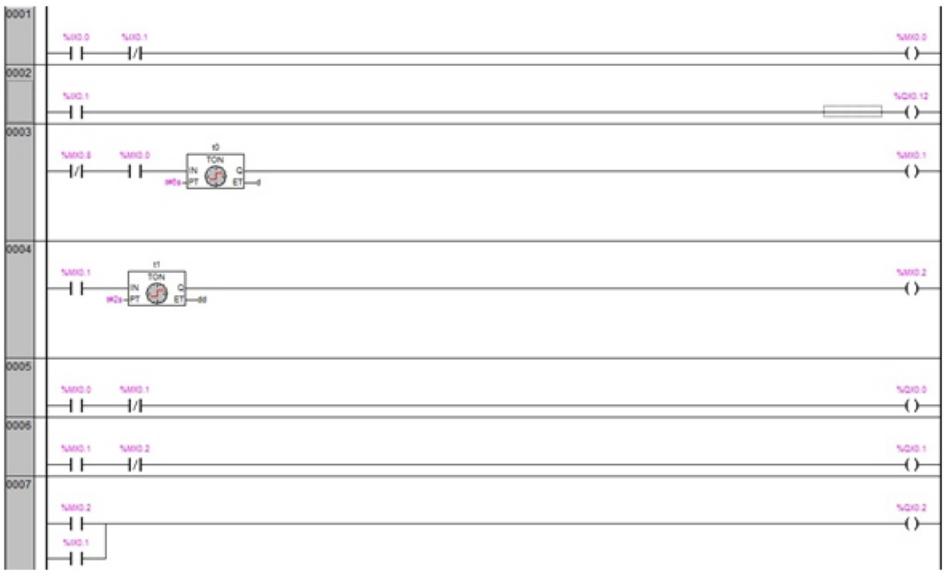

Fig : Ladder Logic in CoDeSys

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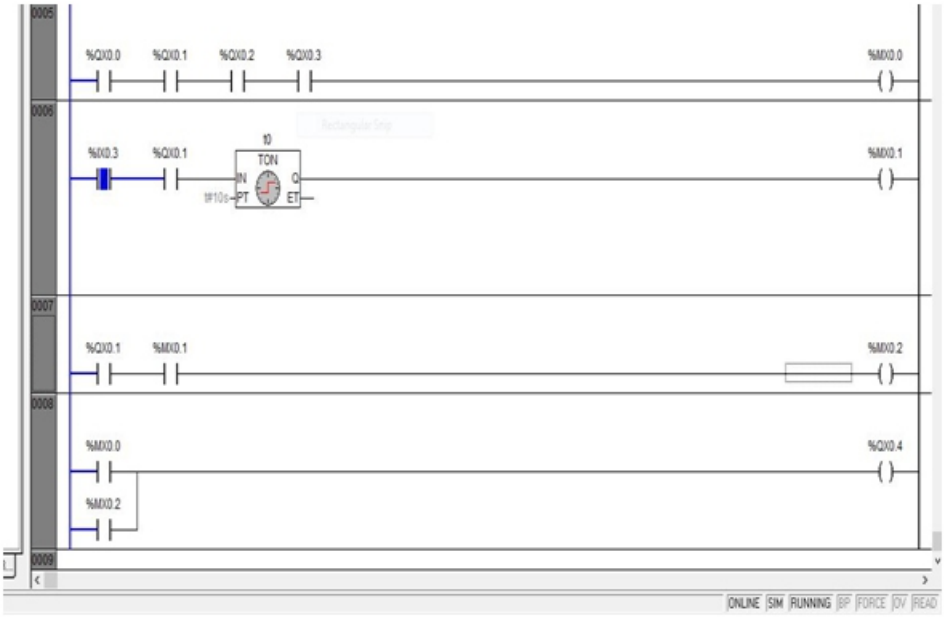

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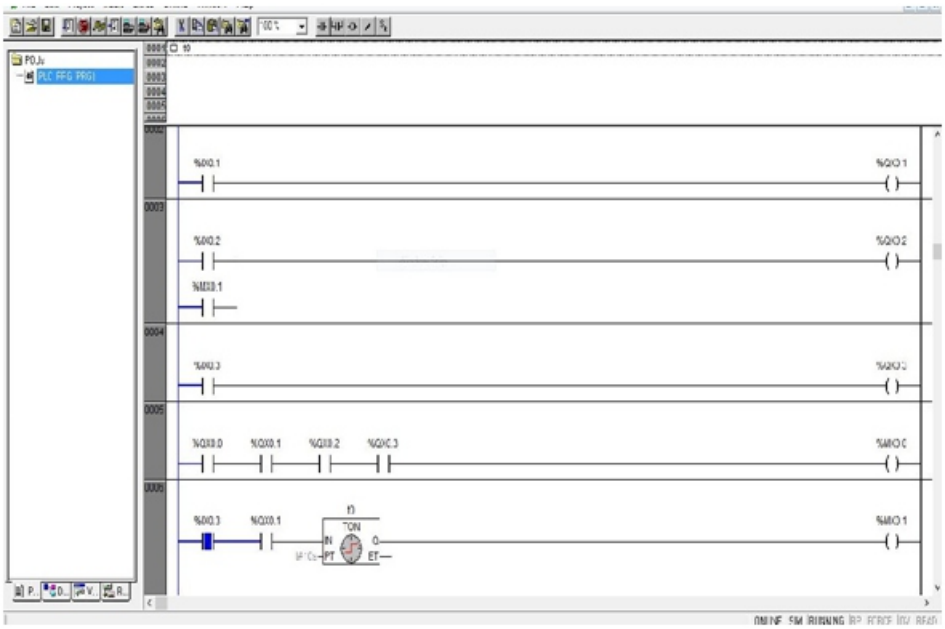

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Table: Table Output Addressing

Date	Time	Level1	Level2	Level3	Level4	Alarm1
13/06/2013	12:59:10	1	1	0	0	0
13/06/2013	13:09:10	1	1	0	0	0
13/06/2013	13:19:10	1	1	0	0	0
13/06/2013	13:29:10	1	1	0	0	0
13/06/2013	13:39:10	1	1	0	0	0
13/06/2013	13:49:10	1	1	1	1	1
13/06/2013	13:59:10	1	1	1	0	0
13/06/2013	14:09:10	1	1	0	0	0
13/06/2013	14:19:10	1	1	1	0	1

Fig: Output Addressing

The developed sensor modules and the SCADA system have been tested. The test results show that the water level can be measured and report correctly through SCADA system. The raising rate of water level also able to be detected by compares the water level from the log file. The example of data log file is illustrated in TABLE II. The developed system is able to show the level of water in each specific area as shown in Figure.

SCADA Screen

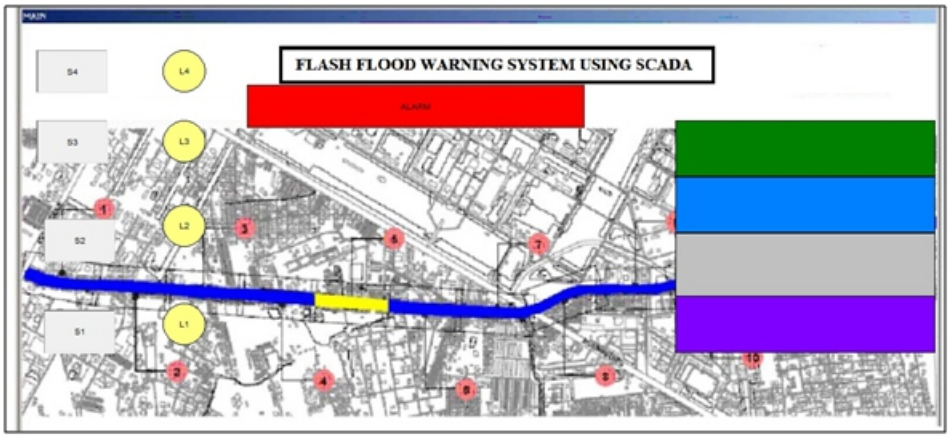

Fig: SCADA Screen in CoDeSys

The above figure shows the output of the warning system as the water level reaches the nodes in which the level sensor is located it alerts the system by generating an alarm as it reaches level 4.

Conclusion:

The flash flood warning system is developed in the CoDeSys programming system.

The conductivity probe is suitable to use as the sensor of the remote station due to its reliability and durability.The data sent from each node can be directly connected to the digital input of PLC.The SCADA system is applicable to the task. The features designed for the industrial such as process monitoring, alarm, and archiving are match the requirement of the flash flood warning system.

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