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Smart Weather Station and Automatic Dam Shutter System

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***Abstract*: Water level in dam need to be effectively controlled in order to avoid complications. This is generally performed manually which requires full time supervision by operators and have fairly large staff compliments. Moreover, the quantity of water released is hardly ever correct resulting in wastage of water and it is impossible for a man to precisely control the gate without the knowledge of exact water level and water in flow rate. The main objective of this project is to develop a system which will detect the level of water and there by control the movements of gates automatically in real time basis which offers more flexibility. This system consists of a set of switches connected to stepper motor through a 8- bit microcontroller. Based on the feedback from the switches used, the level of dam gate can be automatically controlled using a stepper motor. Moreover, it also provides weather condition in and around the dam hence acting as smart weather station.**

***Keywords*: Microcontroller, stepper motor, water level, weather station.**

1. Introduction

A dam is a barrier that stops or restricts the flow of water or underground streams. Reservoirs created by dams not only suppress floods but also provide water for activities such as irrigation, human consumption, industrial use, aquaculture, and navigability. Hydropower is often used in conjunction with dams to generate electricity. A dam can also be used to collect water or for storage of water which can be evenly distributed between locations. Dams generally serve the primary purpose of retaining water, while other structures such as floodgates or levees are used to manage or prevent water flow into specific land regions. During rainy season, floods are very natural to occur. But if they occur heavily then problem will arise. Through this project we are going to build an automatic protection system for dams and reservoirs through IoT based water monitoring technique.

Each and every part of life is somehow linked with embedded projects. Embedded systems are the system of hardware and software co designs. Embedded system is becoming an integral part of engineering design process for efficient analysis and effective operation. From data analysis to hardware work, everywhere embedded products are the main interest because of their reliability time and time bound perfections. Due to time complexity in electronics aspect embedded system have become a major part of daily life. This project describes the design of an embedded system for a microcontroller based dam system and smart weather station. We are using IOT as the communication medium between personal computer and controller. This project uses regulated 5V, 500mA, power supply, LM7805, three terminal voltage regulators for voltage regulation. Bridge rectifier is used to rectify the ac output of secondary of 230/12V step down transformer [5].

Float switches are used in order to mark the level of water in the dam. These switches are placed at different level like high, medium and low in the Dam. The microcontroller is programmed in such a way that whenever the switches at different levels senses the water, the dams shutter will be automatically opened, i.e. once the water level hits the mark of 95%, immediately the dam gates will be opened automatically to the respective level. The gates will be closed after a particular delay.

2. Literature survey

2018 3rd International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU).

Through this paper we got an outline for the development of an information system based on the existing systems with the utilization of some sensors and IoT. It also proposes a novel idea of collecting and sharing real-time information about water levels to an authorized central command center through far field communication. By doing so, the operation of dams all over the country is centralized and automatized.

International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT).

A weather station can be described as an instrument or device, which provides us with the information of the weather in our neighboring environment. For example it can provide us with details about the surrounding temperature, barometric pressure, humidity, etc. Hence, this device basically senses the temperature, pressure, humidity, light intensity, rain value. The brain of the prototype is the ESP8266 based Wi-Fi module

Node MCU (12E). Four sensors are connected to the Node MCU namely temperature and humidity sensor(DHT11), pressure sensor(BMP180), raindrop module. Whenever these values exceed a chosen threshold limit for each an SMS, an E-mail and a Tweet post is published alerting the owner of the appliance to take necessary measures [1].

3. Experimental setup

A. *System design*

The experimental setup contains the microcontroller which is the heart of the system, managing the overall operation of the system. It provides an attractive user interface to interact with external world. The Program is written to help the user use the system effectively directing them to use the system without any problem.

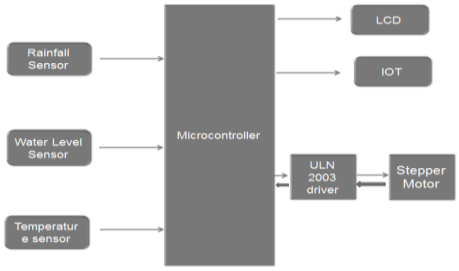

Fig. 1. Block diagram

When the water level reaches the required height the water level sensor senses it and turns off the water inlet valve. The experimental setup contains the microcontroller which is the heart of the system, managing the overall operation of the system. It provides an attractive user interface to interact with external world. The Program is written to help the user use the system effectively directing them to use the system without any problem.

B. *Control board*

The circuit consists of a microcontroller Pic16f877A, a relay driver ULN2003, a 16 MHz crystal,2 10uf capacitors,1 100uf capacitors, 3 pushbuttons, 8 resistors and a LED. The 1, 2, 3 and 4 pins of the relay driver are respectively connected to the 19, 20, 21 and 22 pins of the microcontroller. The output of the motor driver is taken through the 16, 15, 14 and 13 pins of the motor driver which is respectively connected to the 4 motor.

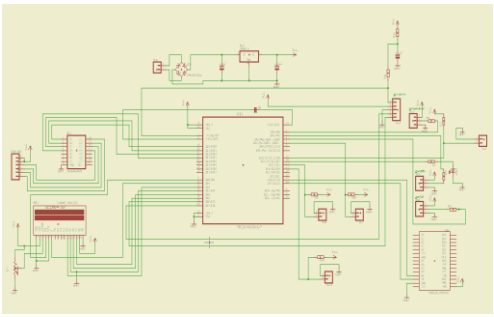

Fig. 2. Schematic of control board

The LED is connected at 27th pin of microcontroller with a 330 resistor at negative terminal of led. Here we provide a power supply of 12v, which is passed in through the bridge rectifier so that we obtain a rectified output.

PIC is a family of microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to *Peripheral Interface Controller* then it was corrected as *Programmable Intelligent Computer*. PIC microchips are designed with a Harvard architecture, and are offered in various device families. The baseline and mid-range families use 8-bit wide data memory, and the high-end families use 16-bit data memory. In this project we are using pic 16F877A [4][3][2].

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in ^{o}C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possesses low self-heating and does not cause more than 0.1^{o}C temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every ^{o}C rise/fall in ambient temperature, *i.e.*, its scale factor is 0.01V/^{o}C.

The HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that:

Distance = Speed × Time [5]

A stepper motor is an electromechanical device it converts electrical power into mechanical power. Also it is a brushless, synchronous electric motor that can divide a full rotation into an expansive number of steps. The motor's position can be controlled accurately without any feedback mechanism, as long as the motor is carefully sized to the application. Stepper motors are similar to switched reluctance motors.

NodeMCU is an open source LUA based firmware developed for ESP8266 wifi chip. By exploring functionality with ESP8266 chip, NodeMCU firmware comes with ESP8266 Development board/kit i.e. NodeMCU Development board. NodeMCU Dev Kit/board consist of ESP8266 wifi enabled chip. The ESP8266 is a Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. It supports serial communication protocols i.e. UART, SPI, I2C etc. [1].

A float switch is a type of level sensor, a device used to detect the level of liquid within a tank. The switch may be used to control a pump, as an indicator, an alarm, or to control other devices.

ULN2003 IC is one of the most commonly used Motor driver IC. This IC comes in handy when we need to drive high current loads using digital logic circuits like Op-maps, Timers, Gates,

Arduino, PIC, ARM etc. For example, a motor that requires 9V and 300mA to run cannot be powered by an Arduino I/O hence we use this IC to source enough current and voltage for the load. This IC is commonly used to drive Relay modules, Motors, high current LEDs and even Stepper Motors. The ULN2003 is a 16-pin IC. It has seven Darlington Pairs inside, where each can drive loads up to 50V and 500mA. For these seven Darlington Pairs we have seven Input and Output Pins. Adding to that we can a ground and Common pin. The ground pin, as usual is grounded and the usage of Common pin is optional.

LCD (liquid crystal display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it. LCDs are used in a wide range of applications, including LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in portable consumer devices such as digital cameras, watches, calculators, and mobile telephones, including smartphones. LCD screens are also used on consumer electronics products such as DVD players, video game devices and clocks.

C. Methodology

The methodology consists of three different section of sensing, controlling and displaying. The Location of Sensing Element Must be First Specified according to the Physical and Environmental condition it will be different in case of Dam water level, Gate opening and Seepage Tank .Selection of Sensors and other components with Correspondence to the site of Implementation which includes Mechanical as Electrical Parameters. The Height of Water level varies with huge span also we require high accuracy and sensitivity is needed. Hence the Ultra-Sonic Sensor is best suitable for the system. As the Errors in Gate Opening are not acceptable the digital display can minimize the observational errors thus, a Quick action can be taken. The seepage tank plays a vital role in dam operation which is often ignored but this ignorance can cause disaster. The Various sensor sense the parameter such as water level, Gate position, Seepage tank level and the data is feed to the Controller. The controller process on the data such as converting from analog to digital and the calculation of sense and gate Height measurement. The nodeMCU is connected to the server which stores the data readied and recorded by the sensors. This data is displayed by the output devices such as Display, SMS Notification and Web Portal.

D. Weather station

Here we provide a power supply of 12v, which is passed in through the bridge rectifier so that we obtain a rectified output. This rectified output is then passed through the voltage regulator (7805) which produces a one arm constant 5V output.5V is required in order to run the pic. Programmer circuit is also added in it; so that the pic can be programmed for the desired work.3-pin convertor is used as sensor in the circuit. LCD is interfaced with the pic, to display the required detail NODEMCU is used to provide temperature and rainfall level to the public via an app called blynk.

4. Results

After thorough testing of our circuit, we obtained the results we expected. We were successfully able to manage the water level by using float switches. It measures the quantities like temperature, humidity and rainfall. With our Ultrasonic Dishwasher we were able to determine the water level in the dam to the authorized users. Thereby providing disaster management. All the parameters measured are updated to an app called BLYNK.

5. Conclusion

We are trying to design a smart weather station that shows the weather features like temperature and rainfall in and around the dam and thereby alert the local people about the present scenario in that area using IOT. We will also be trying to control the dam shutters automatically using float switches. Our inspiration to all this idea was the recent flood in Kerala, India that devastated the lives of many people.

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