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# AN INTEGRATED SENSOR NETWORK TO ENHANCE THE PERFORMANCE OF GULLY POT MONITORING

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***Abstract*—The proposed project deals with the effective monitoring of the Gully pot system. Gully pots can be defined as the centralized collection or storage point for the sewage coming from nearby household from which it goes into the mainstream of sewage pipes and drained into the processing plants for further treatment. Inefficient Gully pot network is the main reason for the over flooding of mainstream sewage pipes. So an efficient design is required for Gully pot monitoring system which is capable of providing sufficient information about the level and pH of the sewage and also to identify the presence of toxic gases produced in the gully pot to avoid human causalities. Also the system is used to identify the blockage in the gully pot using a ultrasonic sensor which helps to avoid flooding of sewer water. These sensors are connected to the PIC microcontroller which recognizes the output of the sensor as its input and does the further processing of those parameters given by the sensors. This processing of the data through PIC microcontroller aids in the monitoring of array of Gully pots present in a locality through SCADA. SCADA provides an advantage of monitoring the array of Gully pots in any base station through which the Gully pots are connected.**

***Keywords- PIC Microcontroller, Blockage detection, SCADA, pH***

## I. INTRODUCTION

A Gully pot is the path in which the sewage enters into the sewers which in turn goes to processing plant for treatment. This idea of building a efficient Gully pot system will aid in better processing of the sewage and avoids the potential risk of flooding during the times of heavy rains. The processing or treatment of the sewage will help in protecting the environment and its own ecosystem. Development of the prototype of an efficient Gully pot system will cater the desired real time efficient system. The proposed system is targeted to the people who are living in the metropolitan cities. The drainage system in any city is not that much efficient to take damage from heavy rainfall. This is because of the lack of surface area to the water to drain in the sea. In order to eliminate this flooding in the street of major metropolitan cities a efficient sewer system must be developed. For this an efficient Integrated sensor network system for the gully pot must be designed. This enhanced Gully pot system will be an effective tool for the corporation sewage department officials to monitor and maintain them efficiently.

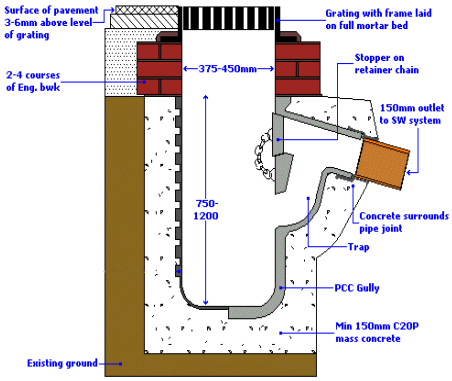


Fig. 1. A schematic representation of Gully pot

## II. ULTRASONIC SENSOR

### A. *Principle*

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The key principle behind the ultrasonic sensor the propagation time delay between transmitter and the receiver. When there is a potential blockage the propagation delay will change according to the size of the blockage.

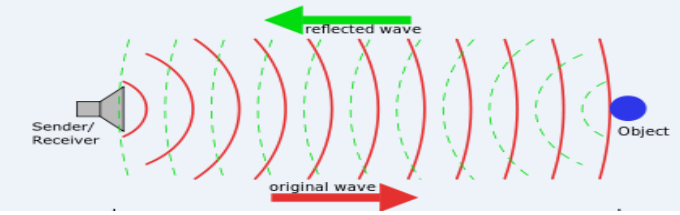


Fig. 2. Principle behind the ultrasonic sensor

*B. Design of Ultrasonic sensor*

The ultrasonic sensor has a transmitter and receiver. Transmitter produces ultrasonic waves if there a blockage present in the pipe the ultrasonic waves shall be reflected back which is in turn compared with no block condition.

*C. Output*

Sensing is only possible within the detection area. The required sensing range can be adjusted with the sensor's potentiometer. If an object is detected within the set area, the output will change state which is visualized by the integrated LED.

## III. GAS SENSOR

A. *Principle*

The principle behind the gas sensor is that when the specific amount gas is introduced, the electrical resistivity of the sensor changes which is propositional to the amount of gas that has been introduced. The gas sensor module consists of a steel exoskeleton under which a sensing element is housed. This sensing element is subjected to current through connecting leads. This current is known as heating current through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the sensing element which alters the value of the current going out of it.

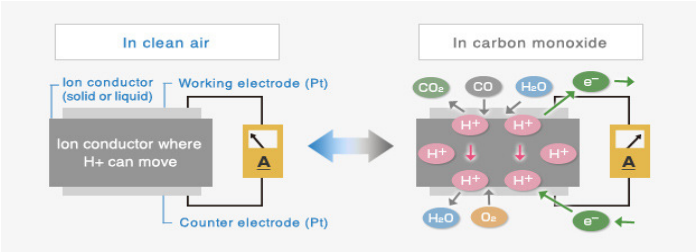


Fig. 3. Principle behind the gas sensor

## IV. pH SENSOR

A. *Principle*

The basic principle of the pH meter is to measure the concentration of hydrogen ions. Acids dissolve in water forming positively charged hydrogen ions (H+). The greater this concentration of hydrogen ions, the stronger the acid is. Similarly alkali or bases dissolve in water forming negatively charged hydrogen ions (OH-). The stronger a base is the higher the concentration of negatively charged hydrogen ions there are in the solution.

Table I. Corresponding output voltages for their respective pH values

| pH value | Output voltage in Volts |
|---|---|
| 1 | 0.5 |
| 2 | 1.0 |
| 3 | 1.5 |
| 4 | 2.0 |
| 5 | 2.5 |
| 6 | 3.0 |
| 7 | 3.5 |
| 8 | 4.0 |
| 9 | 4.5 |
| 10 | 5.0 |
| 11 | 5.5 |
| 12 | 6.0 |
| 13 | 6.5 |
| 14 | 7.0 |

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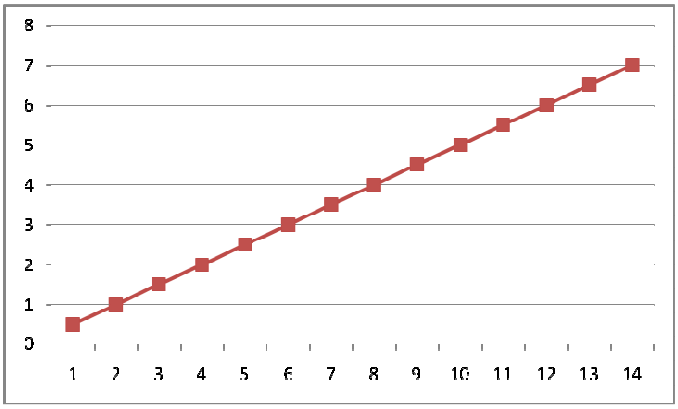


Fig. 4. Graph showing pH versus output voltage

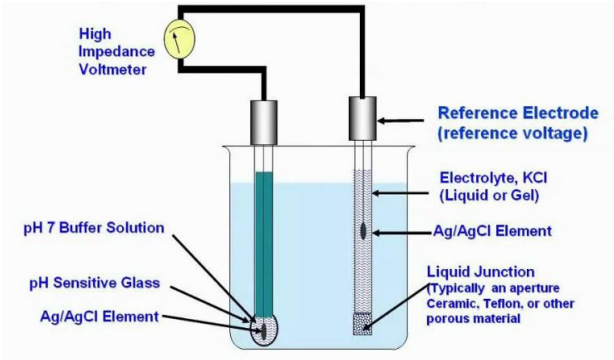


Fig. 5. Principle of pH sensor

## V. LEVEL SENSOR

The level sensor detects the level of the sewage that is present in the Gully pot which can be used to give the information to the station about the level of the sewer water at that particular instant of time. The level sensor produces respective output voltages for the corresponding of the sewer water. This output voltages will be predefined in the program for the level sensor. When the sewer water level reaches the particular levels ( minimum, one-fourth, half, maximum ) the corresponding RFID tags activate the readers and it will be displayed on the system.

## VI. CONTROLLER

A microcontroller is a computer control system on a single chip. It has many electronic circuits built in it, which can decode written instructions and convert them into electrical signals. The microcontroller will then step through these instructions and execute them one by one.

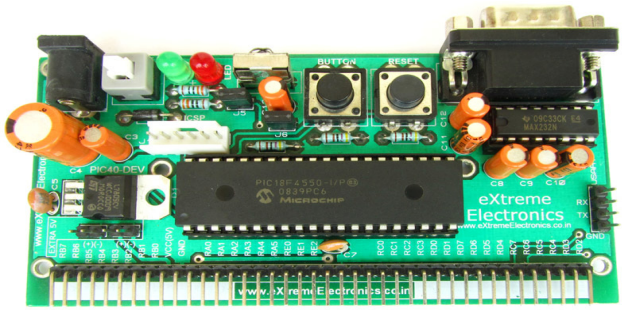


Fig. 6. PIC 16F877A

In PIC microcontroller there are five ports which are named as PORT A, PORT B, PORT C, PORT D, PORT E. In PORT A there are 6 pins (RA0-RA5) such that all the pins present can be used as analog I/O as well as digital I/O except RA4 which can be only used as digital I/O. Directing register decides whether the pin can be used as input or output. In PORT B there are 8 pins (RB0-RB7) such that all the pins available are digital I/O. In PORT B there is a weak pull up register which can be used to drive motors, fans etc. The pin RB0 can be used as external interrupt. In PORT C there are 8 pins (RC0-RC7) such that all the pins are digital I/O. The pins RC6 and RC7 is used for UART serial communication. In PORT D there are 8 pins (RD0-RD7) such that all the pins available are digital. This PORT D has parallel port. In PORT E there are three pins (RE0-RE2) such that all the pins available can be used as analog I/O as well as digital I/O. There are direction registers in all the ports such that they determine the whether the pins in the ports acts as input or output.

## VII. DESIGN OF GULLY POT SYSTEM

The idea of the project has its roots in the damage produced by the rain. If there had been a better drainage system the aftermath effects the rain would been greatly reduced. The implementation of the project in the real time environment starts with the effective design of the Gully pot, which is the gateway for the sewage to enter into the mainstream of the pipes. After the selection of Gully pot, the sensor placed is used to obtain results. The proposed Gully pot system will handle the sewage coming from the nearby household than the conventional ones which are present in our locality. There are four sensors which are present in this

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proposed Gully pot system. The sensors which are present are Level sensor, pH sensor, Ultrasonic sensor, Gas sensor. Level sensor is placed in order to detect the level of the sewer water. pH sensor is placed for determining the pH of the sewer water such that it aids in the further processing of the water. Ultrasonic sensor is placed in order to determine the blockage present in the pipe or passing through the pipe. Gas sensor is present in order to detect the sewer gases present inside the Gully pot. After the sensing it is given to the PIC micro controller to monitor the parameters i.e. Level, pH, Gas and Blockages.

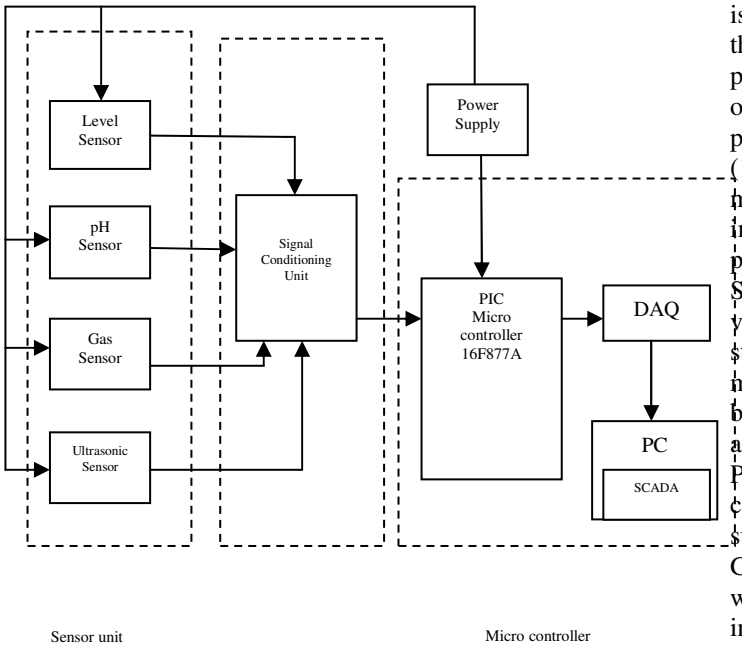


Fig. 7. Block of proposed Gully pot system

## VIII. SOFTWARE DESIGN

SCADA (supervisory control and data acquisition) is a category of software application program for process control, the gathering of data in real time from remote locations in order to control equipment and conditions. SCADA is used in power plants as well as in oil and gas refining, telecommunications, transportation, and water and waste control. SCADA systems include hardware and software components. The hardware gathers and feeds data into a computer that has SCADA software installed. The computer then processes this data and presents it in a timely manner. SCADA also records and logs all events into a file stored on a hard disk. SCADA applications warn when conditions become hazardous by sounding alarms. PIC microcontroller is connected serially with SCADA. The SCADA software consists of the layout of the entire system such that it can be monitored easily. SCADA helps in monitoring array of Gully pots in a efficient and reliable manner.

## IX. IMPLEMENTATION

In the prototype of the system, a drum is taken as Gully pot such that a inlet pipe is connected which is assumed as the inlet for the sewage coming from the household. A ultrasonic sensor is placed inside the pipe for the purpose of the detection of the blockage. A gas sensor is placed on the lid of the Gully pot because gases are lighter than the sewer water. pH sensor is place in a intermediate position of the Gully pot such that the pH can be measured efficiently. Finally level sensor is placed at eccentric position and the level of the Gully pot is obtained. These variables from the sensors place in the Gully pot and given as the input to the PIC microcontroller (16F877A) and it is serially connected to SCADA for the monitoring of the variables coming from the sensors. If this is implemented in real time environment a large number of Gully pots can be monitored which can be accomplished by SCADA. SCADA aids in monitoring the parameters of the various Gully pots present in a particular locality from a single station even if the Gully pot is placed in a remote location. By monitoring these parameters corrective actions can be taken by the officials who are responsible for the maintenance if any undesirable event occurs. There will be alerts from the PIC microcontroller which will be send serially to the computer such that a warning will be displayed on the screen such that it will initiate the officials to check the particular Gully pot section. If that particular alert is rectified the warning will disappear from the computer screen. This will increase the efficiency of both the sewer system and the working efficiency of the officials present for the supervising the sewer system.

## X. CONCLUSON

A prototype of the project will be developed for the purpose of the testing and also for its reliability in the real time application. The prototype will consist of Level sensor, pH sensor, Gas sensor and ultrasonic sensor embedded with a PIC micro controller for monitoring of Gully pot system. The development of the prototype would aid the development of more efficient Gully pot system in the future. As the development of the much better prototype would result in providing a better drainage system for the people living in the metropolitan cities thus creating a better environment for the mankind.

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