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SMART SAFETY MONITORING SYSTEM FOR SEWAGE WORKERS USING IOT

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A B S T R A C T

A large number of sanitation workers die every year due to erratic and lack of facilities available, and harmful toxic gases released while cleaning the sewage. Real time health monitoring systems for such workers will work in a sewage as a safety equipment. In our project, the device will monitor the pulse rate of the person using a Heart beat sensor and theconcentration of CH4with respect to atmospheric O2 and provide alert to the worker and exterior unit when parameters deviate from the safe range. This outcome will promptly alert the worker to stay safe and detect the toxic gases before any harm.

Keywords— *CO(Carbon monoxide); LCD(Liquid crystal display);* CH4 *(Methane*) ; SO2 (*Sulphur dioxide*); MC (*Micro controller*); IOT (*Internet of things*); PPM *(Parts per million*); GSM (*Global system for mobile communication); PWM (Pulse width modulation); IDE(Integrated development environment); IOT(Internet of things);*

1. INTRODUCTION

Sewage system is an underground system of pipes commonly used to transport waste water from homes and business either to a treatment facility, where the water is treated and released into natural water bodies like lakes and streams or in any river to permanently drain out from the area. Sewer manhole is one of the most important parts of the sewer system. Sewer manhole is a structure through which a person can gain access to the underground wastewater collection system. Manholes are not designed for someone to work in regularly, but workers may need to enter inside the manhole to complete their jobs such as cleaning, repair, inspection etc.
The lack of prior caring of sewage work is the witness for the deaths of thousands of sewage cleaners throughout the year from accidents and various diseases such as hepatitis and typhoid due to sudden or sustained exposure to hazardous gases like CO, hydrogen sulphide, methane.

A better knowledge related to hazards in the surroundings is necessary for the prevention of poisoning of gases. These gases have to be keep on track so that enormous rise in the normal level of effluents should be known and corrective measures can be taken. In contrary, the existing systems available are not much portable and are not affordable. In the previous the designed Surveillance rover detects the presence of CO gas for monitoring system.

The device consists of a processing section which takes input, processes it and provides output. This system requires base station should near to the sensors. In our project an embedded system is designed with Arduino MC and various gas sensors for the purpose of detection and altering that helps in eliminating the lives of human which is being endangered. The system is affordable to implement at well-defined monitored.In the existing system, a number of jobs related with gas detection and ensure security system. It has been implemented among these some were theoretical research approach and some were demonstrated in practical field to detect the gas but both approaches were effective manhole gas sensing unit has been developed which is capable to detect the toxic and explosive gases individually within a minute and LCD Display. Harmful gases like CO detection, Methane gas detection, Hydrogen Sulphide gas detection these gases are very toxic to the human, Heart Beat sensor this will be fixed on the workers hand watch and message will be sends to outside workers and Municipal Officers by using IOT.

2 PROJECT OBJETIVE

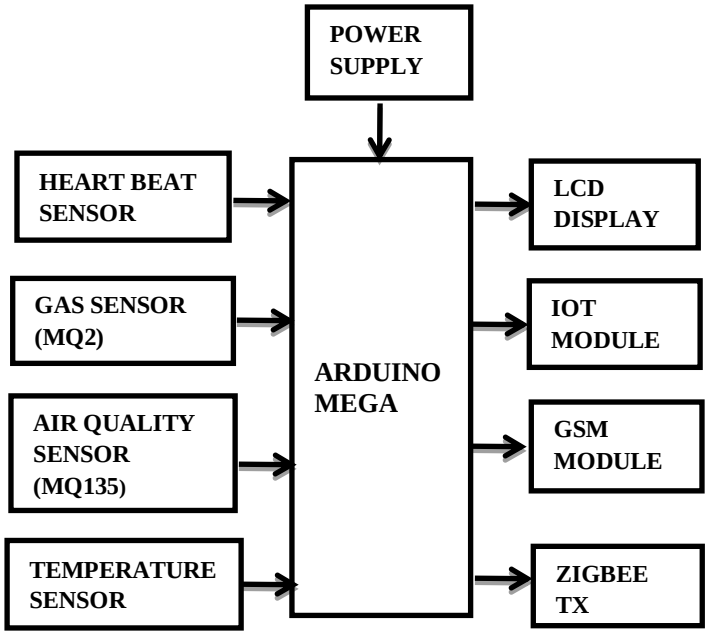
The main objective of this project is to keep the city clean, safety and healthy. To helpcontrators and workers to prevent gas poisoning during drainage work.

3 PROPOSED SYSTEM

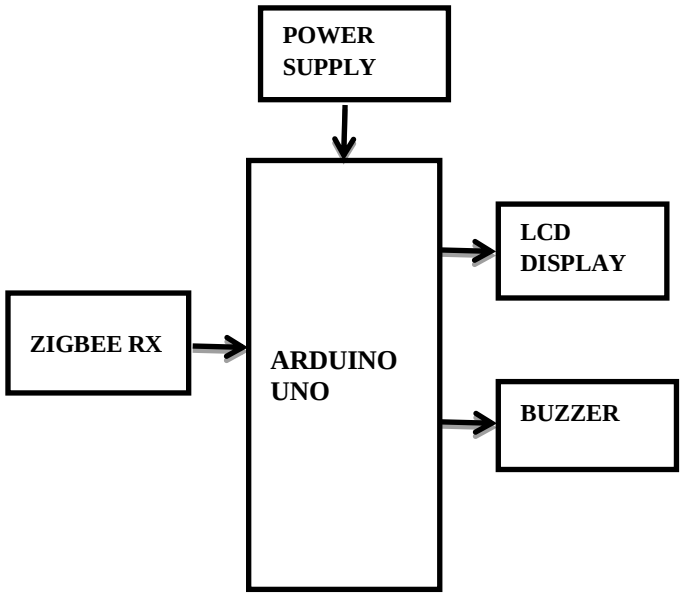
The smart drainage system will have: Sensors to detect blockage, flood and gases. The intelligence of sensors and system will identify the clogging inside the drainage system and will give the details of the location and other information for further actions.The system will also sense the presence of various harmful gases such asCH4, SO2, CO etc.

4 BLOCK DIAGRAM

1.1 TRANSMITTER SECTION:



4.2 RECEIVER SECTION:



5 HARDWARE IMPLEMENTATION

5.1 MQ 2 Gas Sensor

Gas sensors are electronicdevices that detect and identify different types of gasses. They are commonly used to detect toxic or explosive gasses and measure gas concentration. The tin oxide layer acts as a reacting component.When tin dioxide (semiconductor particles) is heated in air at hightemperature, oxygen is adsorbed on the surface. In clean air, donor electrons in tin dioxide are attracted toward oxygen which is adsorbed on the surface of the sensing material. This prevents electric current flow.In the presence of reducing gases, the surface density of adsorbed oxygen decreases as it reacts with the reducing gases. Electrons are then released into the tin dioxide, allowing current to flow freely through the sensor.

5.2 MQ 135 Air quality Sensor

The MQ-135 Gas sensors are used in air quality control equipments and are suitable for detecting or measuring of NH3, NOx, Alcohol, Benzene, Smoke, CO2. The MQ-135 sensor module comes with a Digital Pin which makes this sensor to operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas. If you need to measure the gases in PPM the analog pin need to be used. The analog pin is TTL driven and works on 5V and so can be used with most common microcontrollers.

Fig -1: Gas Sensor

5.3 LM35 Temperature Sensor

LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C. It can easily be interfaced with any Microcontroller that has ADC function or any development platform like Arduino.It has an output voltage that is proportional to the Celsius temperature.The scale factor is 0.1V/ºC. The sensor has a sensitivity of 10mV /ºC.

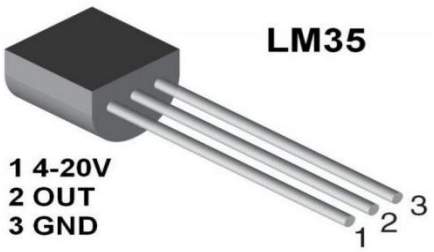


Fig -2: Temperature Sensor

5.4 Heart Beat Sensor

Heart Beat Sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats Per Minute(BPM) rate. The heartbeat sensor is based on the principle of photoplethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ.

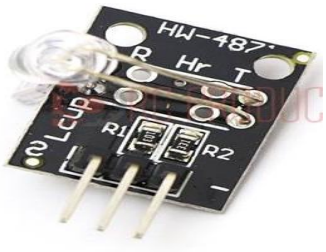


Fig -3: Heart Beat Sensor

5.5 ARDUINO UNO

Arduino board is being used used here. It also reffered as brain which means act as a main part in the project. It is connected with GSM which sends message to the user. Also an application 'Ubidots' being implied here which used as conversion. Wifi modules and LCD display is being connected.Arduino Uno is a MC board based on 8-bit ATmega328P MC. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the MC. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

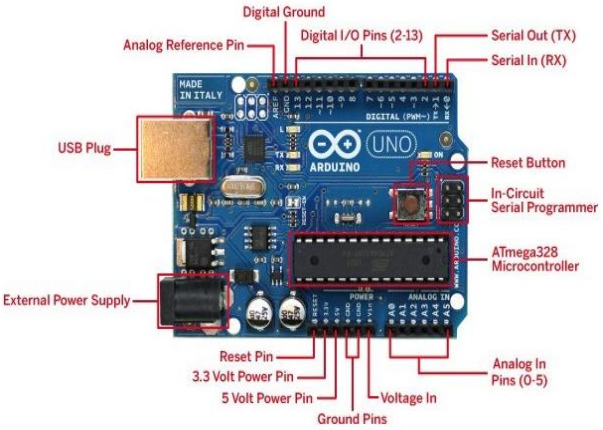


Fig -4: Arduino uno

5.6 ARDUINO MEGA

The MEGA 2560 is designed for more complex projects. With 54 digital I/O pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UART, a 16 MHz crystal oscillator,a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button.The ATmega1280 has 128 KB of flash memory for storing code (of which 4 KB is used for the bootloader), 8 KB of SRAM and 4 KB of EEPROM.

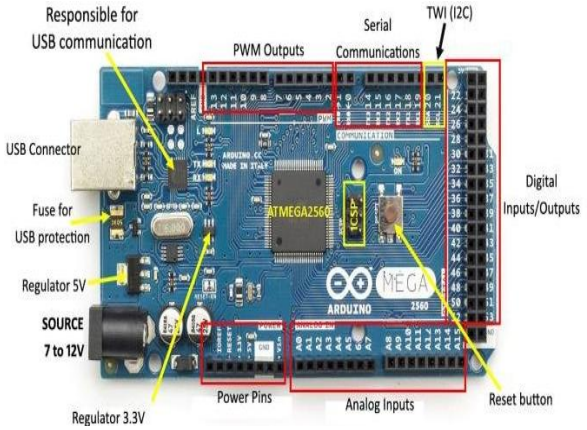


Fig 5: Arduino Mega

5.7 IOT MODULE

The ESP8266 is the name of a micro controller designed by Espressif Systems. The ESP8266 itself is a self-contained Wi-Fi networking solution offering as a bridge from existing micro controller to Wi-Fi.Core processor ESP8266 in smaller sizes of the module encapsulates Tensilica L106 integrates industry-leading ultra-low power 32-bit MCU micro, with the 16-bit short mode, Clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi MAC/BB/RF/PA/LNA, on-board antenna. The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use the add modules to an existing device networking, or building a separate network controller. ESP8266 is high integration wireless SOCs, dthe entire solution, including front-end module, is designed to occupy minimal PCB area.

Fig 6: ESP8266 - IOT MODULE

5.8 GSM Module

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system.GSM/GPRS Modem-RS232 is built with Dual Band GSM/GPRS engine- SIM900, works on frequencies 900/ 1800 MHz. The Modem is coming with RS232 interface, which allows you connect PC as well as MC with RS232 Chip(MAX232). The baud rate is configurable from 9600-115200. The GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as Data transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply . Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and internet through simple AT commands.

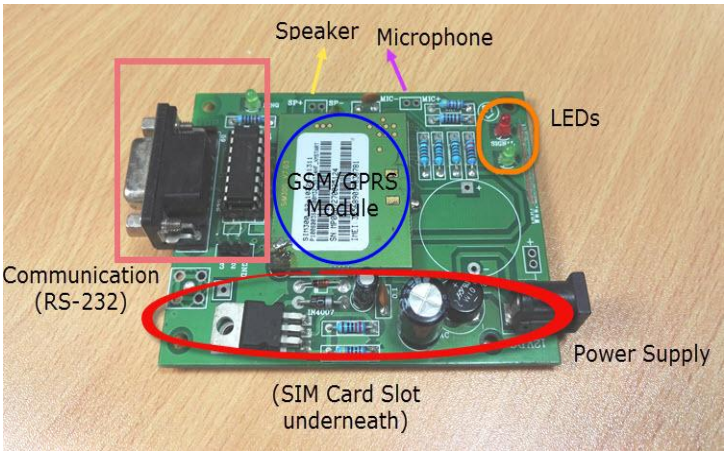


Fig 7:GSM module

5.9 ZIGBEE MODULE

Zigbee is a wireless communication module which use IEEE 802.15.4 standard. 802.15.4 is a IEEE standard for low power applications of radio frequency. It used serial communication to send and receive data.The nRF24L01+ is a single chip 2.4GHz transceiver with an embedded baseband protocol engine, suitable for ultra-low power wireless applications. The nRF24L01+ is designed for operation in the world wide ISM frequency band at 2.4 - 2.4835GHz. The nRF24L01+ is configured in Serial Peripheral Interface (SPI). The register map, which is accessible through the SPI, contains all configuration registers in the nRF24L01+ and is accessible in all operation modes of the chip. The radio front end uses GFSK modulation.**Baud Rate: 250 kbps to 2 Mbps**

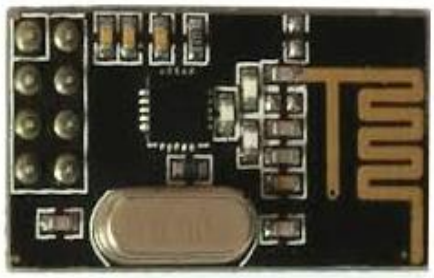


Fig 8:nRF24L01+ - ZIGBEE MODULE

5.10 BUZZER

Buzzer operates based on piezoelectric effect. Piezoelectric Effect is the ability of certain materials to generate an electric charge in response to applied mechanical stress. Piezoelectric buzzer is mainly composed of multi-resonator, piezoelectric plate, impedance match, resonance box, housing, etc. Some of the piezoelectric buzzers are also equipped with light-emitting diodes. The multi-resonator consists of transistors or integrated circuits. When the power supply is switched on (1.5~15V DC operating voltage), the multi-resonator oscillates and outputs 1.5~2.5kHz audio signal.

Fig 9: Buzzer

5.11 LCD

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers Command and Data.The command register stores the command instructions given to the LCD.The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

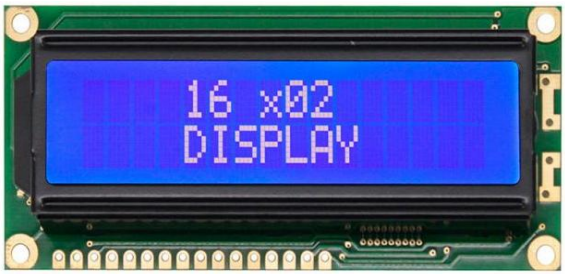


Fig -10: LCD Display

6 SOFTWARE IMPLEMENTATION

6.1 Arduino IDE

ArduinoIDE IDE stands for "Integrated Development Environment":it is an official software introduced by Arduino.cc, that is mainly used for editing, compiling and uploading the code in the Arduino Device. It is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++.Arduino IDE is anopen source software that is mainly used for writing and compiling the code into the Arduino Module. Ithas serial monitor mainly for interacting with the Arduino board using the computer, and is a great tool for real-time monitoring and debugging.

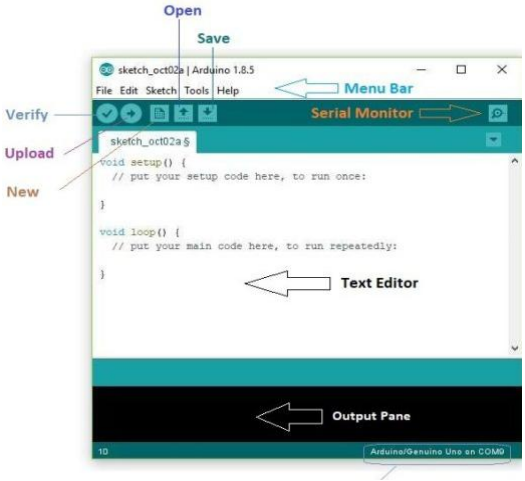


Fig 11: Arduino IDE

6.2 IOT CLOUD STORAGE WEBPAGE

IOT describes the network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet with unique identifiers (UIDs). A host of network protocols for the internet has made it easy to connect sensors to the cloud and to other "things" for efficient data transfer. The data's get stored in the cloud.

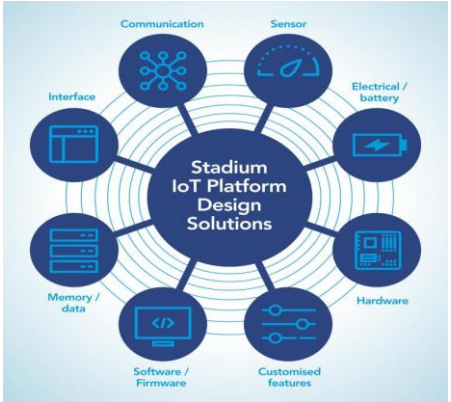


Fig 12:IOT

7 CONCLUSION

Internet of Things has gained its wide popularity in recent days due to its various streams of applications which has paved way for smooth, safe and easier mode of living style for human beings. Though, several techniques is existing for the same, yet sewage cleaning is one major concern and a challenge always. The device finds major application in household sewage systems, municipal manholes and sewage, sewer, deep well, gutters and drains etc. However, the places where toxic gases or fumes are present should never be handled by human workers directly. The smart safety device is cost wise less and fast in accessing the WSN and transfer the information to both the concerned department and emergency department. The proposed device helps the worker at a basic level of knowledge to understand the gas level and his pulse rate.

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