Weight Monitoring System using IoT for Fire Extinguisher Co2 Cylinders

B. R. Raveena sangeetha[1], M. Komala[2], Subasree Venkatesan[3], S. Mallikarjuan Swamy[4]

[1]P.G. student, Department of ECE, SJBIT, Bangalore, India

[2,4]Associate Professor, Department of ECE, SJBIT, Bangalore, India

[3]Managing Director, SriVeda EmSys Ltd., Bangalore, India

Abstract—**A new Weight Monitoring System is promulgated to scale the weight of the fire extinguisher gas. The gas molecules undergoes permeation as per time increases, fire extinguisher dexterity is always lean on the proper concentration of the gas molecule. If gas molecules abridged it results reduction in pressure of the extinguisher gas, then pressure truncates the efficiency of gas extinguishing property. Normally for 3 or 6 months once we need to check the weight of the gas, according to Oil Industry Safety Directorate (OISD) this duration is taken for standard refilling date but when we contemplate CO2 gas as an extinguisher, greater than 10% reduction of gas prerequisite to go for refilling process. WMS device incessantly measure the weight of fire extinguisher gas and sends the message alert about the cylinder to the smart mobile phone using Bluetooth. Each and every 10 minutes the cylinder accessories (SMS) will be sending to the smart phone automatically by WMS device. If the gas molecules seepages more than 10%, then the buzzer gets turns ON and it starts beeping. Until and unless we refill (100%) the gas buzzer won't stop the beep sound, once we done with refilling process buzzer turn OFF.**

Index Terms—**ADC, Bluetooth, Buzzer, Junction box, LCD display, Load cell, TI ARM CortexTM-M4F based Microcontroller board**

I. Introduction

Fire extinguisher Co2 cylinder is a fire preservation contrivance, it is used to annihilate or jurisdiction the small conflagration in extremity situations. Fire extinguishers used in establishment providing accommodation and meals, automobiles , industries other than homestead are required to avoid the damages accurse from the fire. It contains hand held cylindrical pressure vessel containing extinguisher agents such as carbon dioxide, water, fire blanket. These reagents are filled with very high pressure.

The efficiency of extinguisher gas is depends on the pressure of the extinguisher agents inside the cylinder. When we consider carbon dioxide as a fire extinguisher 10% relaxation will be there and for NAF SIII gas as a fire extinguisher 5% relaxation is there. If the extinguisher agents reduce more than 10 and 05% respectively leads the pressure reduction inside the cylinder.

To avoid this disadvantage we are using the WMS device to measure the weight of fire extinguisher gas continuously. These cylinders are very useful for our daily life it has different types of fire extinguisher cylinders, some cylinders are used to control the small fire and some are used to control the huge fire.

The constituents used in weight monitoring system are Arm cortex microcontroller for the accomplishment, BLE for communication between user and device, load cell is to take the input load, ADC is to convert the analog data into digital, buzzer to relinquish the beep circumspect, and power contribute is to switch ON the device.

In addition, the WMS is an IoT enabled device which uses a TrackNmesh® Reader to collect the data from the device and put them on a configured server for immediate alert and notification and for report generation.

Arm cortex is a low cost platform for the evaluation board introduced by Texas instrumentations. It is feasible and useful technology for WMS applications and it has GRB LED for the custom applications, easy to interfacing and extends the functionality. BLE (low energy Bluetooth module) is used for steadfast and infallibility communications. The dominance of BLE is the tranquillity of connectivity and the ultra-low power consumption.

This arrangement explained in this paper succors to scale the weights of each cylinder when we connect serially or weight of one cylinder.

We can also have an alert message when the cylinder weight has been reduced at the same time get the buzzer beeps. Gadget and the user can communicate with low energy dorgi bluetooth module. BLE module is radio telegraphy technology excellence for bartering data over short remoteness from vacuous and mobile gadgets.

The followed paper is methodical as emanated: constituent II chronicle the working of weight monitoring system with all elements make intelligible; Constituent III notifies how the advanced system is put in practice; fragment IV relinquish the secured results with non-identical test occurrences with cessation and finally V gives the fortune work.

II. Weight monitoring system using IoT for fire extinguisher protection

WMS is a device which is used to weigh the fire extinguisher gas cylinder continuously. When gas weight reduces (>10%) it gives the alert and it sends the message which is having cylinder details to mobile by using BLE device. It also sends the mail to the server through the TrackNmesh® Reader. Block diagram of WMS device is as shown in below fig.1. It contains the following components.

1. Microcontroller (TM4C123GH6PM)
2. Bluetooth Low Energy (DBM01)
3. ADC (ADS1232)

4. Load cell
5. Buzzer
6. Power supply

Principle of operation:

The basic functions of the WMS (weight monitoring system) device are measure the weight of the fire extinguisher gas cylinder and give message alert to the user. When we go for serial connection each cylinder requires one Gas Weight Monitor device (WMS). The cylinder should be fixed in hanging condition through load cell. WMS device is operated by two switches, one switch is used to turn ON the device and another one switch is used to turn ON the buzzer. Here buzzer and power supply is connected to red LED and green LED respectively.
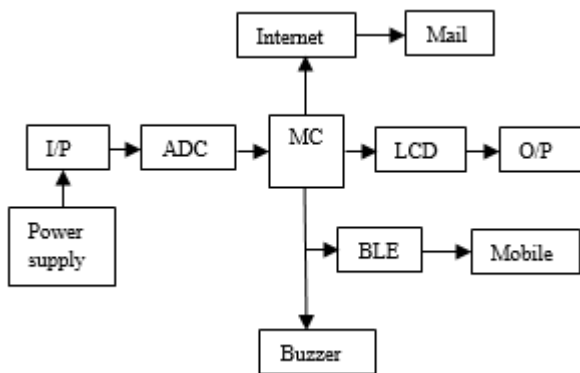

Fig. 1. Block diagram of WMS device

The processor will takes the input reading from load cell. When we connect the load to load cell it take the data and send it to the ADC device, it converts analog data to digital. This digital data sends the information to the microcontroller. Microcontroller processes the data and shows the cylinder details using 7 segments LCD. Microcontroller will also sends message alert through the BLE to the user as well as mail through TrackNmesh® Reader. For every 10 minutes. TrackNmesh® Reader receives the cylinder details through the internet and saves the output data each time. If the gas weight reduces, then buzzer will turns ON and it will not turns OFF until and unless the extinguisher gas have been refilled.

1) Microcontroller (TM4C123GH6PM)

It is a Single-board microcontroller manufactured by Texas instruments. It is an upgraded version of TI's Stellaris launch pad. It has 64 input and output pins, they can easily configure as digital inputs or outputs. It was driven by 3.3V supply and here clock is works with the frequency range from 80 to 120 MHz which makes the devices is 5 to 7 times faster than Arduino UNO.

2) Bluetooth (DBM01)

DBM01 kit is a classification of low energy data conveyance bluetooth device. It is instigate with the satisfactions such as tightly packed size, subsidiary low power expenditure, strapping anti-intervention and long communication remoteness and it also acceptable for short province wireless communication in Internet of Things (IoT).

3) ADC (ADS1232)

It is a 24 bit analog to digital convertor it provides complete front end solution for bridge sensor applications such as weigh scales, strain gauges and pressure sensors. It has on-board temperature sensor to monitor ambient temperature

4) Load cell

Load cell is a transducer which converts one form of energy into other form. It is used to create electrical signal whose magnitude is directly depend on force. Commonly S-load cell is use because of its good resonance value and long life cycle.

5) Buzzer

Piezoelectric buzzer is used to making beeps, sound or alerts when something going wrong. It can be drive by 3.3Vp-p of square wave, while using connect one pin to ground and another one pin to square wave. Square waves may produce from the timer or microcontroller. Buzzer can work with the frequency range from 2 KHz to 10 KHz.

6) Power supply

Regulated power supply is an embedded circuit which is use to convert unregulated AC voltage into Constant DC voltage. By using rectifier it converts AC supply into DC supply and it provide stable voltage to the device or circuit.
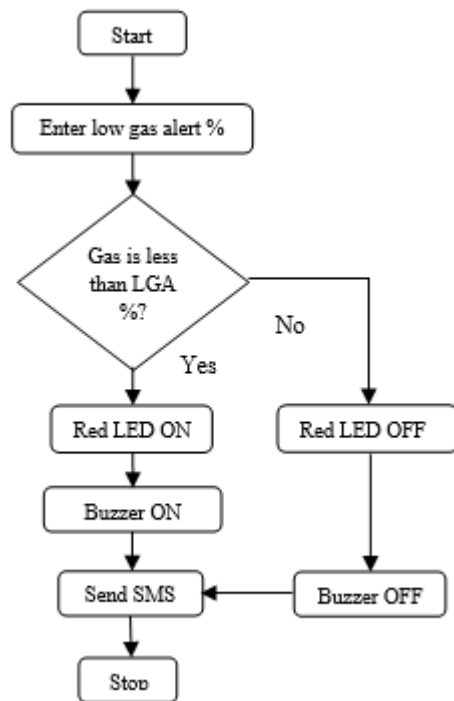

Fig. 2. Flow chart for WMS device working

III. WMS DEVICE IMPLEMENTATION

The unabridged enactment of all the arrangement is done by manipulation of Embedded C programming with embedded workbench (EWB). Implementation steps are as emanated:

1. Advertising the Bluetooth device ID such that whenever Bluetooth is turned ON, it will scan and the device is made visible as shown in the Fig.3.

2. Two switches have been implemented 1 for turn ON and OFF the WMS device and another one for Buzzer.
3. Arm cortex has been implemented to control the entire devices and to dump the code for operation.
4. Load cell is implemented to convert one form of energy into other form, hanging purpose and to increase the value of resonance.
5. ADC is implemented to convert Analog data into digital data.
6. BLE device have been implemented to send the message alert to the user by using mobile application with low power and energy.
7. Seven Segment LCD Display interfacing with microcontroller is implemented to display the gas cylinder details.

The unabridged non segregated contingent with outright functionalities is manifest in the Fig.4 associated block diagram and flowcharts are shown in Fig.1 and Fig.2 respectively.

Fig. 3. Advertising of Bluetooth device ID

Fig. 3. WMS device

IV. RESULT AND CONCLUSION

Weight Monitoring System has been executed with Arm cortex technology to scale the heaviness of the gas cylinder and extinguisher gas and dispatch the vigilant memorandum to user. This apparatus averts the complications such as depletion of pressure inside the fire extinguisher gas cylinder. The advanced representation product is tested with divergent test cases to check persistent and efficient working. Table-I relinquishes the juxtaposition of old system with advanced system. From the table the proposed system has supplemental satisfactions with adjoined attributes differentiate to existing system.

TABLE I
JUXTAPOSITION OF OLD WITH ADVANCED SYSTEM

Parameter	Old module	Advanced module
Accuracy	Moderate	High
Resonance	Less	High
i/o pins	32	64
Complexity	More	Less
Continuous User alert	No	yes
Speed	Less	High
Microcontroller	8 Bit	32 Bit
Flash memory	8K bytes	256 K Bit

V. FUTURE WORK

Additional feature of this system is when the user is out of 100m range he should get message alert as refilling of gas is required. The LCD can be removed and the device can be a small device fitted with a load cell. Modification of the form factor is required. This can be extrapolated to Domestic Cooking Gas cylinders and an analytics with Big Data can help government measure the consumption, demand and plan the supply of cooking gas accordingly.

Government or private funding is required to help in extrapolating this would help a lot in developing this product further for development and conservation and management of various fuels in the oil and gas industry.

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