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AI based Smart Gas Cylinder Stand with IoT

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***Abstract*— The LPG in cylinders are supplied in households as and when requisition placed by the user. It is tough to determine the date and time whne the LPG cylinder will get exhausted, so prebooking and supply of LPG on time is very essential. So a technique to determine the daily consumption level of LPG is very essential to place the requisition for LPG cylinder in advance. So as a solution to this problem faced in every household an AI and IoT based smart gas cylinder stand is designed which monitors the LPG consumption and predicts the number of days the LPG will last.**
The LPG cylinder stand is designed with a load cell with module HX711 for detecting the weight of gas cylinder and then applied to AI to perform the prediction. Along with this the the gas cylinder stand is equipped with sensors to avert accidents like temperature sensor DHT11 and smoke detector MQ2. The function of which is to trigger a water sprinkler when it detects excessive smoke. The water sprinkler DC motor is also attached to the top of the platform.

***Keywords*--- ANN, Load cell module HX711, Temperature sensor DHT11, Gas sensorMQ2, DC motor, IOT, AI, Smart Gas cylinder stand**

I. INTRODUCTION

INTRODUCTION - The LPG in cylinders are supplied in households as and when requisition placed by the user. It is tough to determine the date and time when the LPG cylinder will get exhausted, so prebooking and supply of LPG on time is very essential. So a technique to determine the daily consumption level of LPG is very essential to place the requisition for LPG cylinder in advance. A LPG gas cylinders do not a LPG consumption indicating system mounted on it , so we propose an AI based smart Gas cylinder stand we can determine the amount of LPG left in the cylinder.

In this paper a gas cylinder stand is designed which will monitor the LPG level in the gas cylinder and predict how many days it will last for also prevent any major accident by measuring temperature around it. The proposed Smart gas cylinder stand is designed using a load cell with module HX711 to detect the weight of the gas cylinder . Similar type of designs were proposed in [1,2,3,4]. But we have includes AI to determine the number of days the LPG will be available based on the daily consumption. This data of the weight of the cylinder is uploaded into the Adafruit IO cloud at regular intervals. We can monitor our LPG usage and analyse using the Adafruit IO Analytics. and then the data is applied to an ANN model to predict for how many days the LPG will last.

The temperature sensor DHT11 attached to the wooden platform helps detect increase in temperature [2]. It will trigger an alarm if the temperature rises above 50 degree C. We also used a smoke detector MQ6 attached to the platform. The function of which is to trigger a water sprinkler when it detects excessive smoke. The water sprinkler DC motor is also attached to the top of the platform. These data for smoke and temperature is also uploaded to the Adafruit IO cloud for keeping a close watch.

II. COMPONENTS AND IMPLEMENTATION

Mainly use the following components to make a “IOT based Smart Gas Cylinder Stand with Artificial Intelligence”:
HX711 (Load Cell Module)

2. Load Cell
3. NODEMCU ESP8266
4. MQ-2 sensor (Gas and Smoke detector)
5. DHT-11 (heat and humidity sensor) / IR Fire Sensor
6. Mini submersible water pump
7. Arduino Relay module
8. Sprinkler Nozzle

A. HX711(Load Cell Module) - HX711 load cell amplifies module uses an integrated 128 internal programable advance amplifier with 24 high-precision ADC converter chip HX711.It is designed for high-precision electronic scale and configuration with 2 analog

input channels. The HX711 communicates on two wire interfaces (clock and data). It is specially made for amplifying signals from cells and reporting them to another microcontroller.

B. 5kg Load Cell - We are using load cell in our system for the purpose of weight sensing. It senses the weight of the cylinder and gives the output to the microcontroller. Microcontroller checks the output and takes the necessary action if required. A load cell measures mechanical force mainly the weight of objects.

Digital load cell/strain:

$$R = \rho \, l/A$$

R = Resistance
ρ = property of material
l = length of wire
A = cross-section area of wire

C. NODEMCU ESP8266: Node MCU is a development board with ESP8266. Its basically an SOC and a code both the Arduino and WIFI module separately, it can connect objects and let data transfer using the WIFI protocol.

D. MQ-2 sensor (Gas and Smoke detector): MQ-2 gas is an electronic sensor used for sensing the concentration of gases in the air such as LPG, Propane, Methane etc.MQ-2 gas sensor is also known as chemiresistor. It works on 5v DC voltage and can detect the gases in the concentration of range 200 to 10000 ppm. [5]

E. DHT-11 (heat and humidity sensor) / IR Fire - The DHT11 is a basic, ultra low cost digital temperature and humidity sensor basically a capacitive humidity sensor and a thermistor [4].

Relative Humidity = (Density of water vapor/ Density of water vapor at saturation) x 100%

F. Infrared fire sensor is an electronic device used to detect the presence of fire or other infrared source.

G. Mini submersible water pump - It's a low cost, small size submersible pump motor which can be operated from 2.5~6v power supply. It is mainly used in fire- extinguishers. It uses a motor to power an impeller which is designed for rotating and pushing water outwards.

H. Arduino Relay module: An Arduino relay module is a small board embedded with either one or two relays and a combination of resistors, diodes, transistors. It is an electrically operated switch that can be turned On or Off, letting the current go through or not and can be controlled with low voltages like the 5V that is provided by the Arduino pins.

I. Sprinkler Nozzle: The spray of water is developed by the flow of water under pressure through small nozzles.

III. WORKING PRINCIPLE

The Smart Gas Cylinder stand will be necessary thing in people's life. The gas cylinder stand is designed with these features.

A. Detecting low levels of LPG in the cylinder
B. Monitor the daily consumption of LPG
C. Predict for how many days the LPG will last based on the average LPG consumption rate and Artificial neural networks
D. The temperature sensor and MQ-2 gas sensor attached to the wooden platform helps detect any rise in temperature and gas leakage respectively and the water sprinklers will be switched on immediately.

The working principle of the IoT and AI based Smart Gas Cylinder is as below:

The load cell attached to the wooden stand will measure the weight of the LPG cylinder and upload the received weight to cloud. Temperature sensor and smoke gas detector sensor will observe the smoke, temperature and humidity and upload to cloud if it detects smoke. Temperature, humidity and weight will always be uploaded to cloud over the IoT using the NODEMCU ESP826.

The weight detected will be saved in the cloud from the day 1 and everyday the LPG consumed will be measured to determine the following parameters:

- Daily consumption of LPG
- Average daily consumption of LPG
- Remaining weight of LPG.
- Day count

These parameters are applied to the ANN model and the number of days the LPG will last will be determined by the ANN model. The ANN model was trained with a dataset based on these parameters to determine the number of days the LPG gas cylinder will last.

For this the ANN model is trained with a data set. Now this ANN model with the above said inputs will predict how many days the LPG will last

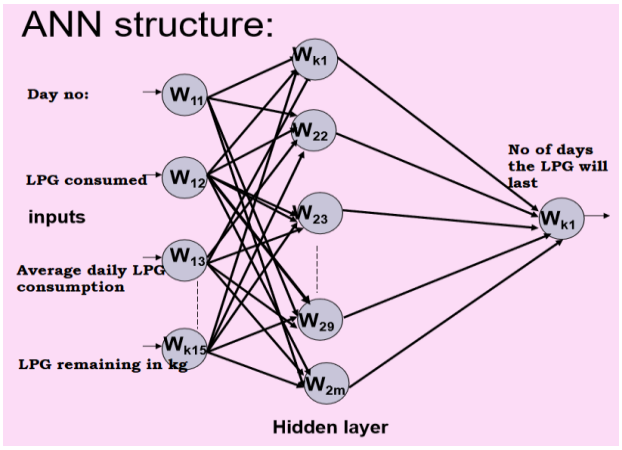

Figure 1: ANN model for Smart Gas Cylinder Stand

The Smart Gas Cylinder stand will be necessary thing in people's life. LPG leakage detection and accident prevention the systems works in the following way:

The temperature sensor, smoke detector, take the environment parameters and the data is sent to cloud using the NODEMCU ESP826 . If the temperature is recorded by the temperature sensor raises above 45 degrees and the smoke detector detects smoke/LPG, then the water sprinkler will be triggered and the water will start falling through the sprinkler, then the alarm will sound immediately. If there is no problem, then temperature, humidity and weight will continue to be uploaded to cloud.

So the IoT and AI based smart Gas cylinder stand will support the LPG monitoring.

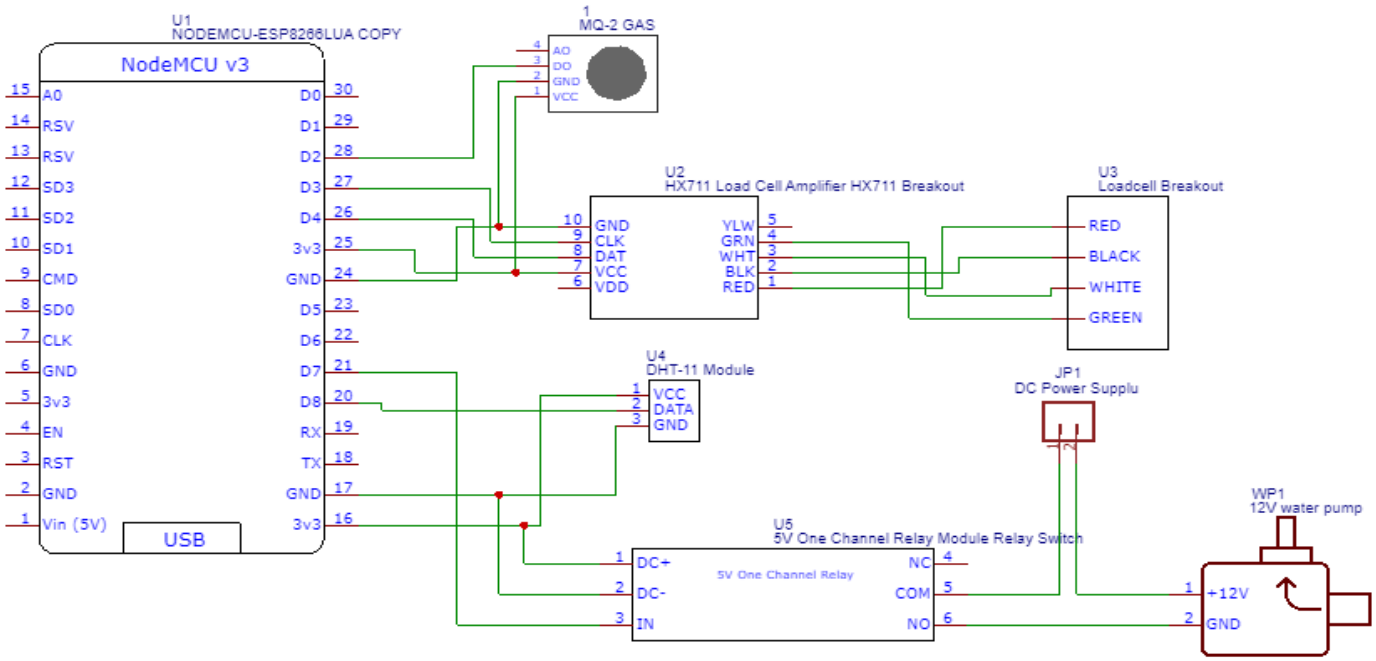

Fig. 2: Circuit Diagram

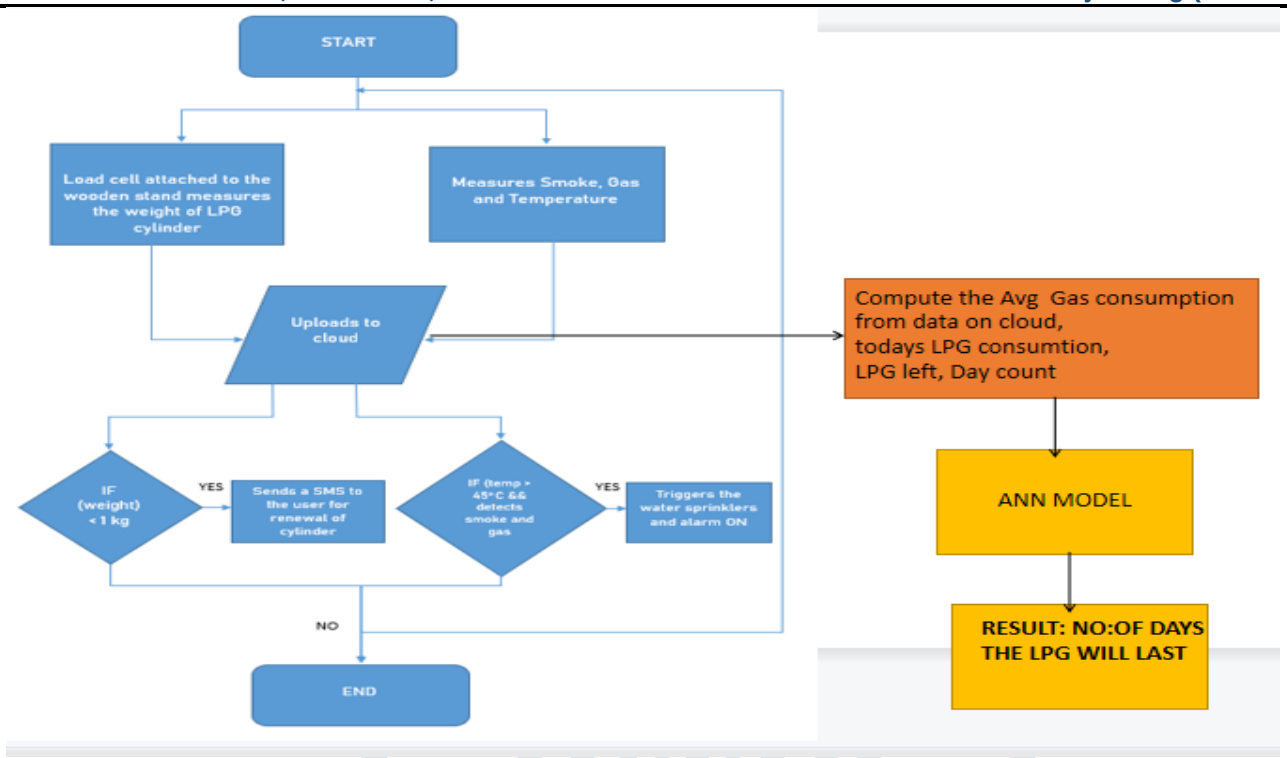

Fig 2: Flow Chart of Smart Gas Cylinder's working principle

IV. OBSERVATIONS

The Smart Gas Cylinder stand works according to the flow chart of Fig.1. Temperature, humidity and weight are always uploaded to cloud when the smart gas cylinder stand works. In the table below here are some test results by following the working principle of Smart Gas Cylinder and the AI output predictions for the no:of days the LPG will last.

TABLE I
ANN MODEL PREDICTING THE NO. OF DAYS THE LPG WILL LAST

Day count N	Weight of Gas cylinder in gm	LPG consumption on the nth day in gm	Average daily LPG consumption in gm	Amount of remaining LPG in gm	No: of days the LPG will last theoretically	No: of days the LPG will last theoretically as per ANN
1	14200	198.224	198.224	14001.776	70.6	69.99
9	12511.454	220.114	212.07	12291	57.95	58
18	10450	122.795	215.1295	10327	48.006	49

V. CONCLUSION

In this paper we present an innovation for society where the LPG monitoring system with Artificial intelligence has been developed number of days the LPG will last. The LPG consumption analysis and prediction of and accident prevention system is designed. In this system the number of days the LPG will last will be determined and predicted. A accident prevention system based on small variations in sensor parameters has also been developed.This being a step ahead of the LPG monitoring systems.

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