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Sensor based automated washroom monitoring system

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***Abstract*—Sanitation is one of the basic necessities required by the human race. Various statistics shows that poor sanitation is a cause for various life threatening diseases. In our work we consider the hygiene of washrooms in public places as they are places from where diseases can be contracted. The cleanliness of washrooms in airports, malls and other public places also decide on business, as customers will be unsatisfied if washrooms are not cleaned regularly. Taking into consideration the various positive benefits of cleaning washrooms consistently in public places we have come out with an automated sensor based system which monitors washrooms for cleanliness by monitoring the air inside the washroom. The air inside the washroom can indicate various components of gases present inside the washroom thereby helping to identify whether the washroom is clean. If the values exceed the threshold value then an alert is sent via text to the cleaning team at the public space.**

Keywords—sensor; air quality; hardware; washrooms; automated alert.

I. INTRODUCTION

Most of the infectious diseases are contracted from public spaces [1]. Hence hygiene of washroom in public places has to be maintained. This is a very difficult task, since public places are used by large number of people, and it is almost impossible to know the cleanliness of the washroom even after periodic checks.

In places like airports, shopping malls and almost every other place visited by a large number of people washroom hygiene is essential. Our work aims at providing a solution for this problem, by developing a sensor based module which will provide an alert to the maintenance team.

Existing washroom cleaning methods are traditional which means, audit is done periodically and if washroom is found to be dirty then cleaned. But this method is not an effective solution. Our work aims to overcome this problem by designing a sensor based module which has sensors connected. The inputs provided by these sensors are taken up by a processor which will compare them to predefined values of gases like ammonia, oxygen, methane and carbon-monoxide. The system can function better with more sensor inputs considering the various gases present inside a dirty washroom. If value of a combination of gases crosses a particular threshold then an alert is sent to the maintenance team.

This system can also be considered not only in air ports but also place like bus stops where we are unable to access the washroom due to the stink and dirt.

Even if the stench spreads to about 100 meters in a bus stop it is totally ignored by the maintenance team. Such a system can be placed in this scenario and an alert message can be sent to the respective corporation authorities, who in turn can immediately check with the maintenance team. Thus this system will be able to bring in accountability and also provide better sanitation facilities to the common man.

II. PROPOSED SYSTEM

The proposed system is designed as a hardware module with various sensors integrated into this module which provides inputs about the air quality inside the washroom. For our work we have considered various gases which when present inside the washroom, change the air quality and provide an indication on the cleanliness of the washroom.

The gases we had considered were Methane, Ammonia, Oxygen and Carbon Monoxide. The work can be optimized for precision if we consider many more gases to define the air quality inside the washroom.

A. Block Diagram

The proposed system was designed and the block diagram of the proposed system is shown in Fig 1.The proposed system consists of various sensors provided to a signal conditioning circuit. The sensor inputs after signal conditioning are given to an ADC of 10 bit resolution which converts the inputs to digital.

These inputs are given to an algorithm with predefined values which when exceeded will cause the system to provide an alert message to the maintenance team through GSM module interfaced with the processor. The system also provide an alert by interfacing a CLCD(Character LCD) with the processor which continuously scrolls a message about the amount of gases present inside the washroom.

The proposed system can be made accurate by statistically measuring gases from a large number of washrooms and setting a precise threshold value. This system is a generalized model which can be place in washrooms anywhere irrespective of the place.

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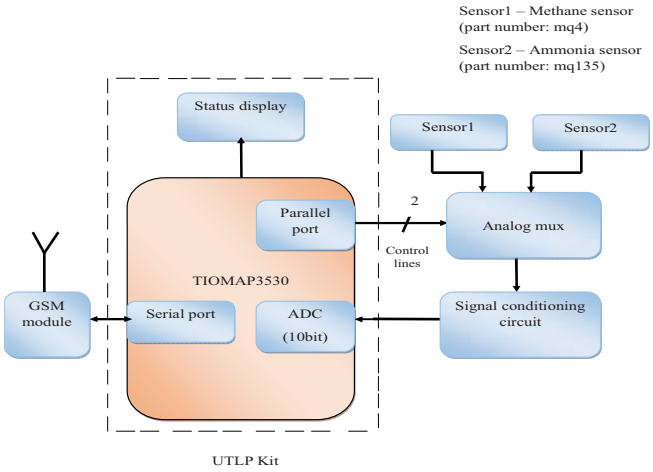

Fig.1. Block Diagram of Proposed Design

B. *Experimental Setup*

The experimental setup of the proposed model is shown in Fig 2.The work was prototyped and we have we considered sensors MQ4-methane gas monitoring sensor, MQ135-ammonia measurement,MQ-7 for carbon-monoxide measurement and G37-for oxygen monitoring. These sensor inputs are given to signal conditioning circuit.

The output from the signal conditioning circuit is then provided as input to an analog to digital converter of 10 bit resolution, which inputs these to the UTLP (Unified Technology Learning Platform) kit.

The kit is based on a 32-bit TIOMAP3530 processor which can be used for power constrained applications. Thus keeping in mind a battery operated module we have considered this processor. The inputs are given to an air quality monitor algorithm which gets input values and compares them with threshold values.

If the inputs from sensors cross the threshold limit, then a message is generated and sent through a GSM module interfaced to the prototype. This message alert can be sent to pre-programmed numbers of washroom maintenance team or in-charges for them to take immediate action.

The designed system not only sends a message but also displays the status of the parameters inside the washroom through a CLCD display. This can be useful to audit the washroom premises and take necessary action thus providing a better sanitation system in place.

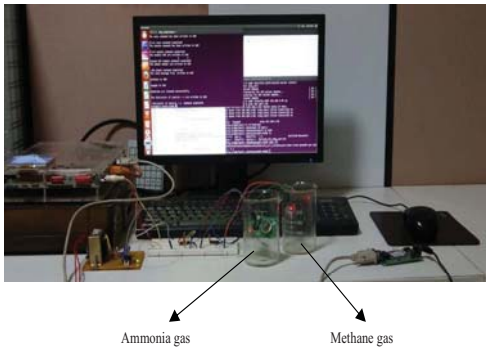

Fig.2. Experimental setup of prototype

III. Results and Discussion

The work considered a system to check hygiene of washrooms and provide better sanitation for the common man. A prototype for the same was designed and developed using various sensors and the TIOMAP processor.

A. *Test Case*

The prototype was tested for the following test cases
Test case-1: Acquiring inputs from sensor
Test case-2: Processing data and GSM intimation
Test case-3: Display of gases present in CLCD.
Fig.3. shows the considered Testcase3
Thus the work was designed and tested.

Fig.3. Display of gases present in CLCD

IV. Conclusion

In our work we have considered the problem of washroom hygiene maintenance and provided a solution for immediate status update of washroom hygiene, by designing and building hardware based prototype module with sensor inputs. It has been found that by monitoring air quality inside a washroom we can arrive at comprehensive conclusion that the air quality inside a washroom is an indicator of the hygiene of the washroom.

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V. FUTURE WORK

Our work can be future enhanced by considering new parameters by introducing more sensors for precision. This means that in future this prototype can be developed in to a product with large number sensor inputs where each one of them will define a specific parameter of air quality. The same work can be carried out using PIC microcontroller and a cost effective hardware product can be developed for the benefit of common man especially in a country like India where people die each day due to improper sanitation. A small step in this direction can bring huge changes.

ACKNOWLEDGMENT

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