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An integrated subsystem for basement flood detection

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ABSTRACT

Disaster Management accords with the response to the management of resources and property. It is the exigency in today's world. Flooding has become a global pervasive in the past decades which hampers economical and social development. This project endeavours an integrated flood risk management system employing a magnetic reed switch interfaced with microprocessor Arduino UNO using microcontroller 328p. The build out in the architecture of the buildings into apartments and complexes have made a requisite for basements. This device is hence installed in the parking lot and basement of apartments, malls and corporate buildings as the water reaches a particular level the reed switch gets closed generating an alert .The residents of the apartment or the authorities of the building get an SMS through GSM module followed by an alarm. Now once excess water starts accumulating, water suction motor is used to remove water to prevent the rapid rise of water. Thus the reed switch is interfaced with arduino for flood detection and the raising water level in the basement of buildings and alert people for easy evacuation. The comparison of the reed switch and the previously used sensors is done and the results are obtained.

Keywords: *Magnetic Reed Switch, Arduino UNO, GSM*

1. INTRODUCTION

Disaster Management concurs with the reaction to the administration of assets and property. It is the extremity in this day and age. Considering floods the speed and the flow of water into the residential area cannot be controlled but an early alarm system can be enacted helping the people evacuate and sending an alert to the rescue team. This device ishence installed in the parking lot and basement of apartments, malls and corporate buildings in urban areas. However, this would require modification to work in urban areas containing radar shadow and layover. The development of a near-real time algorithm for urban flood detection thus remains a challenge. [2]Although there are numerous methods using ultrasonic, precipitation sensor and zigbee modules which have found lot of drawbacks in lifespan for flood detection. This paper emphasizes the use of a magnetic reed switch which is superior in operation and lifetime when compared to the previous methods. An alarm or buzzer is interfaced with the magnetic reed switch in order to alert the nearby residents. The residents and the authorities of the flat get an SMS.A water suction motor is also interfaced to prevent the rapid rise of water so that the residents can escape. Power management is one of the key factors since power is shut down during flood. An inverter is interfaced to run the entire setup so that the power shut down will not be a major concern.

This setup can be used in frequently flooded areas of Maldives, Bangladesh, China, river belts of India at a much reduced cost so that it is available to all walks of people. This system can not only be used for flood but also for any liquid level monitoring where human interaction with the device is difficult since it can withstand extreme climatic conditions and can withstand electrostatic discharges and the reed is not influenced by the external properties or other magnetic particles. Depending upon the usage the size of the sensor can be fabricated which is more reliable for usage.

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1.1 Method Used

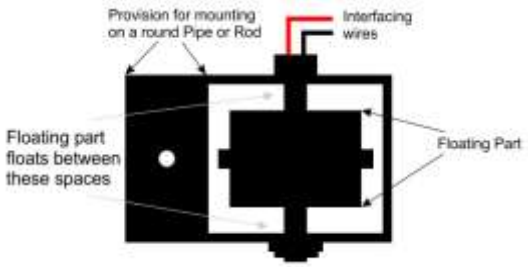

Fig. 1: Internal Structure of Reed Switch

The magnetic reed has two or more contacts that are sealed in a hermetical inside a glass or plastic tube with an inert atmosphere. The size of the reed switch can be fabricated in different sizes ranging from 18mm and to withstand different environmental conditions. The magnetic reed switch is made of plastic or glass enclosure so that it is not easily broken. The external part of the switch is coated with ruthenium (Ru) for longer life and the leads are plated with pure tin (Sn). The voltage capabilities, power demands, lead configurations and contact configurations can also be met using reed switches.

1.1.1 Functions

The switch generally operates in three basic configurations

A. Normally closed(NC)
B. Normally open(NO)
C. Form C(both NC and NO)

The reed blades act as conductors and are also called as "magnetic antennas"

1.1.2 Operation

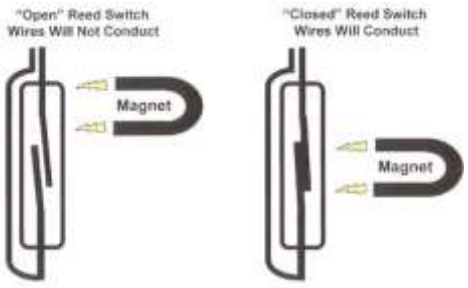

Fig. 2: Operation of Reed Switch

In the detection of the liquid level we use the third type Form C which encloses both the NC and NO types.The form C is a SPDT (Single Pole Double Throw) Switch. As a push is felt in the bottom end of the switch the two conductors close indicating the required level of the liquid and sends alert through the arduino board.The magnetic reed switch can also be used as a latch until reset of the magnetic field. Another way of activating the switch is the production of magnetic flux through electrical contacts, as the magnetic interaction between the contacts causes the switch to close. For this operation the orientation of the magnet and relative location of the reeds play an important role. Care must be taken in the orientation of the magnet and the sensitivity of the reed switch should be checked before implementing the device in the entire setup. In order to meet the tolerance of mechanical systems the orientation of the reed switch with respect to the position of the sensor.

1.1.3 Power Management System

During the flood, power shut down is one of the major issues in order to operate the device hence two alternative power sources are suggested:

A. AC Generator: Since every apartment would afford a generator it can be used as an alternative to activate the motor and the reed switch
B. Fuel Cells: These are electrochemical cells which acts an oxidizing agent combining the hydrogen and oxygen ions. This reaction is used in a battery and produces only DC supply which can be converted into AC supply using an inverter. This cell has the capacity to store charges and act as a significant one.

2. EXISTING SYSTEMS

There are numerous existing systems for the detection of flood which have resulted in one or few drawbacks and some of the techniques used are discussed below:

A. Precipitation Sensor

In the beginning of time when flood detection techniques were adapted the precipitation sensors were used. The sensors were based on the moisture content that gets deposited on top of the sensor and alert is given to the residents. Even for very slight variations in the climate due to the increased moisture content. Hence this technique cannot be used and it was used near rivers and dams.

B. Ultrasonic Sensor

These sensors work based on the sound produced due to the water approaching near the sensor. The major drawback occurring in its usage is that it even senses the heavy sound of rain or any huge sound in the external environment. The ultrasonic sensors were used near dams and open air areas. These sensors were hung above a few meters from the ground and resulted in failure.

C. Zigbee Module

This model was a transceiver model used as an alert system in case of flood. This system has a major drawback of losing signal and it can be used only once since the device was not durable and was not water resistant. When the device got submerged in water it failed to transmit the signal. Hence this technique was not adapted further.

3. PROPOSED SYSTEM

Considering the disadvantages of the previous systems a new flood detection and alert system based on the magnetic reed switch. The description of the magnetic reed switch is already given in section II. This alert system consists of arduino attached to the

reed switch. As water reaches a particular level the circuit gets closed and buzzer is activated to alert the residents. The lights present start flickering and the owners of the home are alerted with an SMS and a call alert.

Fig. 3: Reed Switch interfaced with Arduino and GSM Module

4. RESULTS AND DISCUSSION

As water reaches a particular threshold level in the basement of the building, the reed switch gets closed and alert is generated using sound alarm and flickering of light in individual flat. The GSM module transmits a message to the resident's phone number.

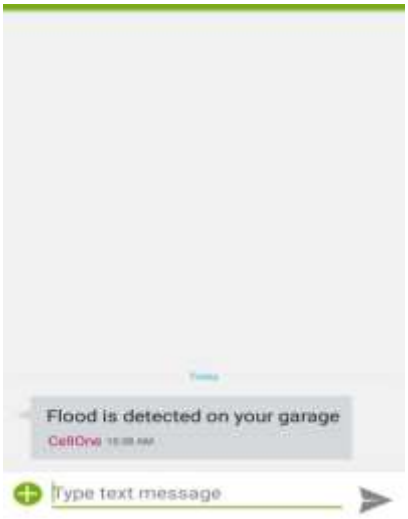

Fig. 4: SMS alert to the residents

A comparison of the errors occurring in the previous systems used and the magnetic reed switch is proved using the flowing outputs plotting the occurrences vs. the errors in mm and the conclusion is obtained

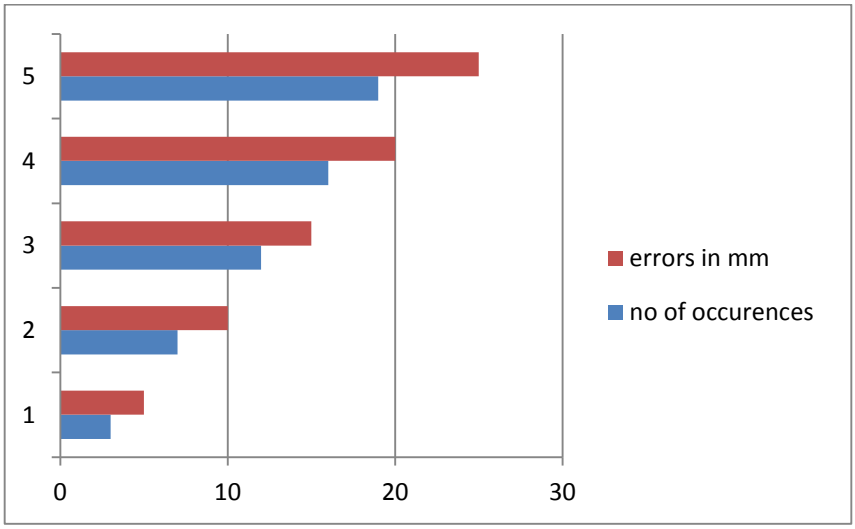

Fig. 5: Ultrasonic Sensor Errors

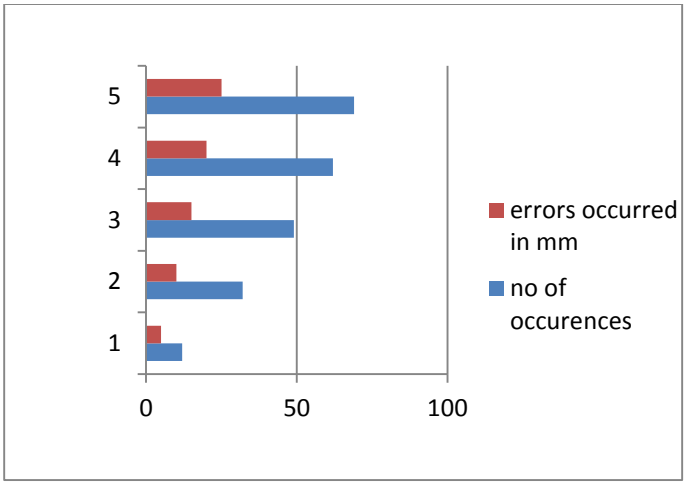

Fig. 6: ZigBee Module Output

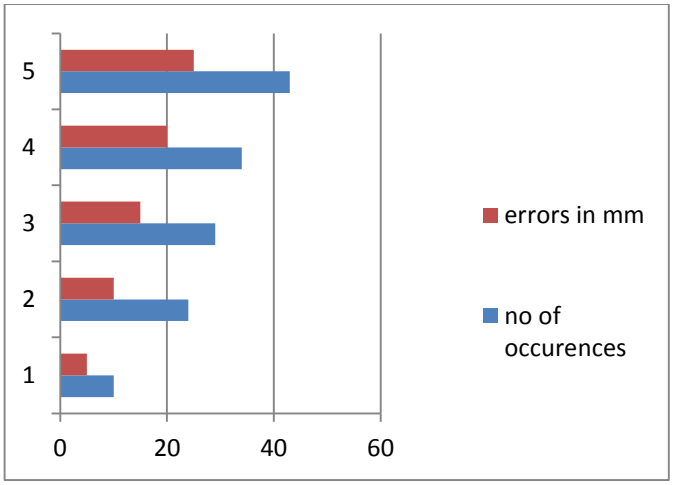

Fig. 7: Precipitation Sensor Output

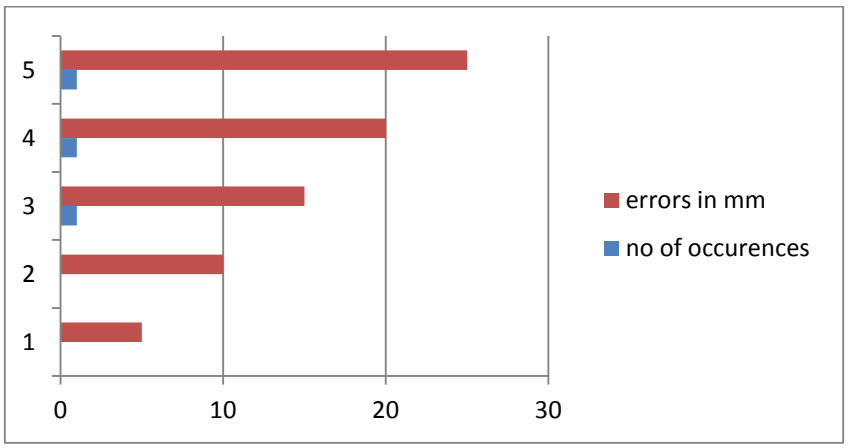

Fig. 8: Reed Switch Output

From the above results we conclude that the usage of magnetic reed switch has minimum or no error even as the level of water increases. The remaining sensors fail to transmit an alert when submerged in water and in certain cases the sensor is completely damaged and has to be replaced for efficient working. Overcoming all the above disadvantages the magnetic reed switch is able to function properly and can withstand the external ESD and highly robust. Thus the reed switch can be preferred and implemented over the other existing systems.

5. CONCLUSION

Even though there are various systems existing in the detection of flood the magnetic reed switch has exceptional properties to withstand the external environmental conditions. The plots also show that the flood detection using reed switch has reduced number of errors. Thus the reed switch can be used for detection of flood and the raising water in the system and alert people for easy evacuation.

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