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Automatic Waist Airbag Drowning Prevention System

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ABSTRACT—
In this paper we propose the automatic airbag system helping evacuating swimmer who is motionless or spent abnormally long time underwater. The system is composed of a customized waist airbag and monitor equipped with pressure sensor and accelerometer. The monitoring system through Zigbee will try to define accurately the position of the swimmer's head the whether underwater or not by comparing the real-time measured pressure to an estimated value of over the water surface pressure. If the time-lapse spent by the swimmer exceeds a predefined maximum threshold or the measured accelerometer information shows that he has been motionless for long time period underwater, an on device alarm is triggered and a signal is sent to the servomotor connected to the deflation system of the airbag to trigger it and evacuate the swimmer.

Index terms-ARM; LCD Display; PC; ZIGBEE

I INTRODUCTION

Drowning is the third cause of unintentionally injury death in the world. In United States it is considered the second cause of death among children under 12. Worldwide, children under 5 have the highest drowning mortality rate . Drowning accidents occurs even in swimming pool staffed with professional lifeguards. It is very hard for normal people to identify people drowning. Parents are required to watch permanently their children while they are swimming in the pool. However, this is practically difficult to ensure, as humans lose easily their attention.

Drowning is considered silent and rapid death. In less than one minute a person can drown silently without being able to call for help. There are few commercialized wearable drowning prevention system. SenTAG is a wrist band based system which triggers an alarm if the swimmer is motionless for twenty seconds under a certain depth. WAHOO is a head band based system which sends alarm if the swimmer spends a long period under water. These systems require the installation of equipments in the area where they are used. Which can make from the systems costly for private swimming pool as well as not suitable for large swimming area such sea? These systems also consider the presence of lifeguard nearby to respond to the alarm. In this research we aim to create an affordable drowning prevention system which can be flexibly used in various locations. For this we make use of the recent advancement in Smart phones equipped with pressure sensor and accelerometer which we attached at the swimmer's head level. We developed and application which can measure the motion and time spent by the swimmer underwater and compare it to a predefined maximum time-lapses threshold. So if an abnormal behavior is observed on device alarm is triggered and waist airbag is deflated to evacuate the victim.

II EXPERIMENTATION SETTING

2.1 The Waist Airbag

ARM-LPC2148 is a 64 pin processor which is a 32bit RISC processor core. If the person or researcher went into the sea or a river if

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the person feels drowsiness or abnormally long time under water then there is a chance to a person may drown. In order to rescue the person I propose an automatic waist airbag system which is equipped with MEMS Accelerometer and pressure sensor.

The swimmer condition is good or not is judged by his moments. so in real time we the take hand moments of the person as an input but in order to develop project prototype we take the vibrations through a device called MEMS Accelerometer. It is a motion detector. MEMS Accelerometer which used is MMA7361 which is a 3-axial accelerometer. As we know if we want point any object position we take X-axis-axis and Z-axis. Likewise in this MEMS consists of 3-axial output pins X,Y,Z which are connected to the ARM ADC pin because the output from MEMS is an anlaog signal so in order to convert it into digital value this wire is x-axis wire is connected to ARM ADC pin. port0-28 pin and these MEMS value is displayed on the LCD display and also transmitted to the PC wirelessly through ZigBee.

Here ARM transmitter pin is connected to the Zigbee receiver pin .If the MEMS value(vibrations value) crosses the threshold value or zero then the motor(submersible pump) and voice IC is activated and a message is dangerous is displayed on LCD. Through this submersible pump airbag is filled with air then the bag bulges then person may come to surface level.

In the same Way we apply pressure on pressure sensor .If the person goes more beneath of the sea or river area then the pressure increases and going in depth into the water the oxygen level will be decreased it may lead to death of the person so in order to avoid this pressure sensor is used in order to calculate the pressure of the water. when pressure value is increased and automatically voice IC is activated and submersible pump is activated an airbag is filled the person comes to the surface level of the water.

Here all these operations are controlled and processed by ARM-7. Zigbee is used as an wireless medium which is a 802.15.4 standard it is a personnel area network which can transmit data wirelessly 100m long. Here zigbee transmitter is connected at swimmer and the receiver is connected to the PC here one person is monitoring the swimmer in PC .So swimmer vibration values and pressure values are sent to PC wirelessly. Based on these values the monitoring person may know the condition of the swimmer and an cause occurs he may take immediate action.

III SYSTEM DESCRIPTION

3.1 MEMS Accelerometer:

Accelerometer is a sensor that measures the proper acceleration of an object. In this research we use it to measure the motion of the swimmer. For this we calculate acceleration square root accSQR:

$$accSQR = \frac{x^2 + y^2 + z^2}{g^2}$$

We calculate then maximum accSQR (max_accSQR) during a predefined time window W. We compare then accSQR with a predefined accSQR threshold (accSQRth) to check the swimmer motion.

3.2 Pressure sensor:

Pressure is the force per unit area applied in a direction perpendicular to the surface of an object. The measured pressure is sensitive to the environment where the sensor is located. We have conducted several experimentations in a water tank on the pressure sensor to identify the effect of waterproof case and swimming cap on the measured values (Fig.2).Pressure variation according to the pressure sensor location The results show that the measured pressure decrease by about 65 Pascal when the Electronic device is enclosed in the waterproof case. The pressure decrease again by about 42 Pascal when the Zigbee is inserted in the swimming cap. The current air atmospheric pressure value is very

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important as it is used to identify the whether the head position of the swimmer is inside or outside the water. As the pressure fluctuation is relatively important from one environment to another, it is important to ensure that the system defines properly the correct atmospheric pressure reference value at the beginning.

IV RESULTS

Fig.1:System design without power supply

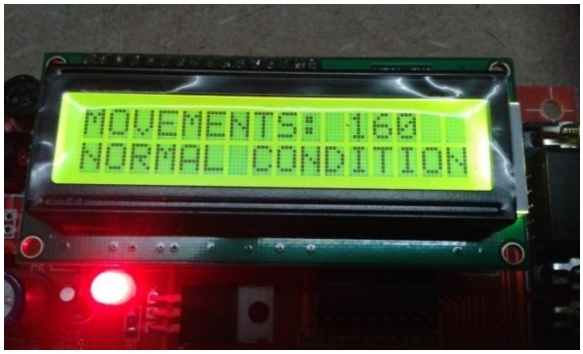

Fig.2: MEMS value and in normal condition display on LCD

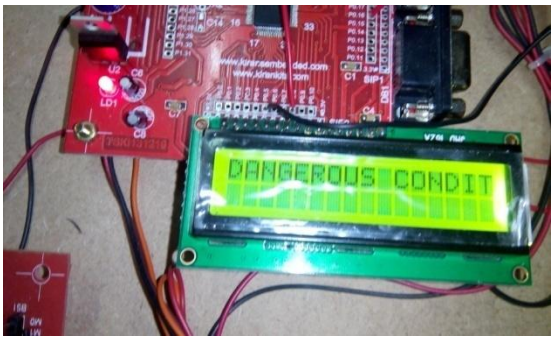

Fig .3 MEMS value is more then display dangerous condition on LCD.

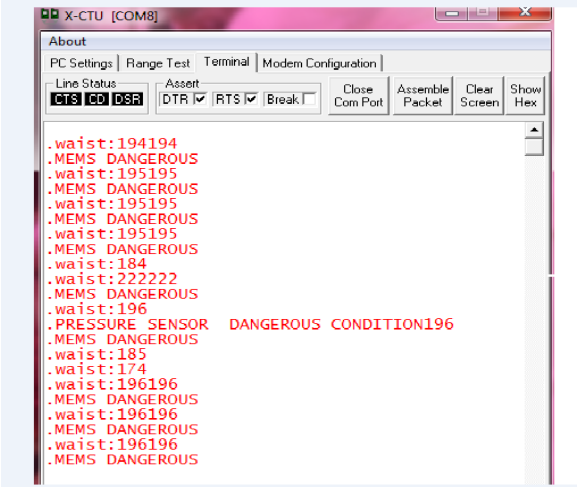

Fig:4 PC Results of Monitoring system

V CONCLUSION AND FUTURE WORK

In this research we show how we can use Zigbee as a platform for drowning alarm system, using the embedded device accelerometer and pressure sensors. We show also the efficiency of pressure sensor in detecting swimmer's head position: whether it is outside or inside water. When the swimmer submerge his head in water, we were able to measure a sensitive pressure changes at just one inch depth. Information from accelerometer was used to identify the case when the swimmer is motionless. So if an abnormal behavior is measured in either of these two cases an airbag is deflated. In the future we consider conducting further experimentation in order to define the appropriate parameters of the system which are necessary to reduce false positive alarms. We are also currently working on developing further more this system to detect the victim at early drowning stage by analyzing his physiological body changes .

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