Embedded Tsunami Warning System

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Abstract

Today Tsunami is the very wild natural disaster that threatens the mankind. An automated warning system should be designed to measure the pressure variations under the sea. So in the case of anyabnormal rise in the pressure level under the sea, an alarm is produced as well as messages are sent to concerned persons using mobile computing. In this study a proximity capacitive sensor and embedded micro controller is designed to announce the oncoming of Tsunami to the authorized person.

Keywords:

Cross Compiler, Embedded System, Microcontroller, Sensors, Transmitter.

1. Introduction

A Tsunami is a very long-wavelength wave of water that is generated by earthquakes that cause displacement of the seafloor, but Tsunami can also be generated by volcanic eruptions, landslides and underwater explosions. Tsunami occur suddenly, often without warning, they are extremely dangerous to the coastal communities.Tsunami earthquakeshowever,are a rare class of earthquakes that rupture more slowly at 1-1.5 km per second and propagate up tothe sea floor. This makes the vertical uplift much larger resulting wave heights up to 10-20 metres.

In our design, specifications includes AT89C2051 (Atmel) which is programmed to transmit and receive signals.IR Transmitter transmits the detected signal. TSOP 1738Receiver receives the detected signal.Mobile computing is used for warning purpose.The Software programs are designed such that they are capable of handling all possible exceptional conditions.

The advantage of using an embedded system for developing a Tsunami warning system is its accuracy and speed and also it uses capacitive sensors which are highly sensitive even for a small level pressure changes. Moreover, this system has very long life and it is cheaper than the existing system.

2.Hardware Description

1.1. Microcontroller

Microcontroller used in this study is AT89C2051. It is a 20 pin DIP. The AT89C2051 is a low voltage, high performance CMOS 8 bit microcontroller with 2K bytes of Flash programmable and erasable read only memory. The AT89C2051 provides the following standard features: 2K bytes of flash, 128 bytes of RAM, 15 I/O lines, two 16 bit timer/counters, and one five vector two level interrupt architecture, a full duplex serial port, a precision analog comparator, on-chip oscillator and clock circuitry. The AT89C2051 supports two software selectable power saving modes: the Idle Mode and the Power-down Mode.

1.2.Transmitter

The infrared LED emitter produces a light beam across the bottom of the coil. IR (infrared)rays is chosen because there is less noise and ambient light than at normal optical wavelengths. LED is used as transmitter and it uses Infrared rays to transmit the signals.The transmitter module diagram is shown in figure1:
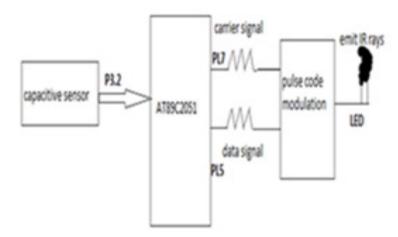

Figure 1. Transmitter Module Diagram

In the transmitter module, the capacitive sensor senses the change in capacitance. If the actual value exceeds the target value then it considers that there is some abnormal condition. The value is given as interrupt signal on the port P3.2 of AT89C2051 microcontroller. As a result, the data signal and carrier signal are generated by the microcontroller.Data signal is pulse code modulated with the carrier wave. Negative pulse code modulation is performed. The signal is passed to receiver in the form of IR rays with the help of LED.

1.3.Receiver

TSOP 1738 is the receiver used in this study which has the capability to receive frequency with the range of 38 kHz. TSOP 1738 is the standard IR remote control receiver series, supporting all major transmission codes. The receiver module diagram is shown in figure 2.
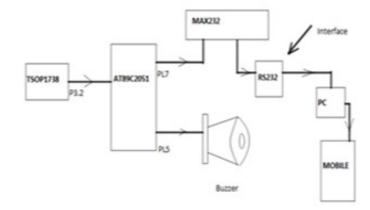
Figure 2. Receiver Module Diagram

In the receiver module,TSOP1738 receives the signal in the input pin.This is given as input to another AT89C2051 microcontroller on the interrupt pin P3.2. The PC is interfaced with the microcontroller through MAX-232 level converter, in order to convert TTL logic to RS logic. In MAX-232 11th pin takes the microcontroller TTL logic and process it and then gives the RS logic output on the 14th pin. The buzzer is interfaced with the microcontroller on the port P1.5.

1.4. Capacitive Sensor

Proximity capacitive sensor is used in this study. This sensor contains a dielectric material separated by an electric plate and comparator. When there is any variation in capacitance value, the comparator compares the actual value with the target value. Based on this principle, capacitive sensor gets operated.

1.5. MAX-232 Level Converter

The MAX-232 level converter is a 16 pin DIP. It contains dual charge pump DC-DC voltage converters, RS 232 drivers, RS 232 receivers and receiver and transmitter enable control inputs.

1.6.RS232

RS232 devices can be plugged straight into the computers serial port. This is referred to as COM port. The data acquisition device used here is capacitive sensors. Its output is fed through microcontroller. In warning phase mobile is connected to PC through the RS232 port.
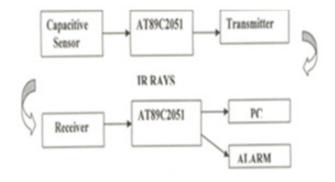
Figure 3. Block Diagram of Tsunami Warning system

The block diagram of Tsunami Warning System is shown in figure 3. In this Tsunami warning system, by varying the capacitance value of proximity capacitive sensor, signals are sent to the microcontroller in the transmitter side. Microcontroller passes infrared signals from an IR transmitter. These IR rays are received by the receiver. The signal is passed to the PC through the serial port. Immediately, after the signal is received by the PC, it sends alert message to the mobile attached. Simultaneously it raises an alarm.

3.Software Description

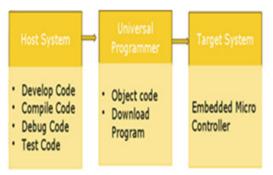### 1.1.Embedded Software Design

Figure 4. Embedded Software Design

The Embedded software [embedded c] is developed compiled debugged and tested at the Host system. The tested code is downloaded into microcontroller as object code using universal programmer. Then the chip is removed from the universal programmer and embedded into the Target system. The Embedded software designis shown in figure 4.

When starting a new project, microcontroller to be used from the Device Database should be selected and the µvision IDE sets allcompiler,assembler,and linker and memory options. The Keilµvision debugger accurately simulates on-chip peripherals.A cross-assembler is used that can translate a text file written in Assembly language into a binary file that can be uploaded into the microcontroller.

1.2.KEILµVISION2

This is used to compile the code written for the microcontroller. The microcontroller code is written using embedded C. It encapsulates the following components:

- A project manager.
- A make facility.
- Tool configuration.
- Editor.
- A powerful debugger.

1.3.VB.NET

VB.NET is designed to be the easiest and most productive tool for creating .NETapplications. It provides the following features:

- Common Language Runtime.
- Language Interoperability.
- Enhanced security.
- Simplified deployment.
- Improved versioning support.

The controls used in this project include:

- Microsoft Communication Control: It provides serial communications for the application by allowing the transmission and reception of data through a serial port.

- Oxygen Mobile SMS Control: This is used to send message to the destination user via SMS. Oxygen Mobile ActiveX Control has modules messaging. These modules are independent and can be used together or separately from each other.Each module or their combination has methods for establishing phone connection and retrieving basic phone parameters.

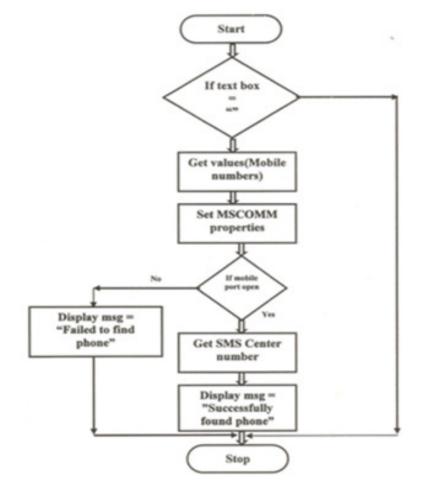The following flowcharts illustrate the Tsunami warning system:

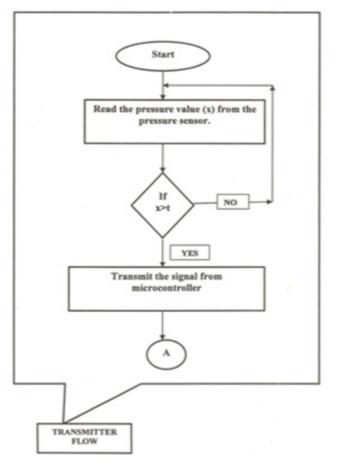Figure 5. Basic steps followed during Initiation (during Tsunami)

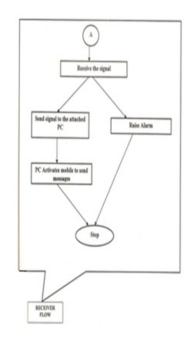Figure 6. Transmitter Side Flow(during Detection)

Figure 7: Receiver Side Flow During Detection

4. Result

The output screen of the Tsunami warning system while executing it is shown in the figure 8:

Figure 8. Form Design in dot net

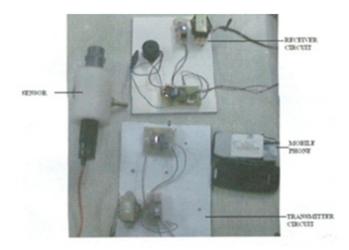The prototype of the developed system is shown in the figure 9:

Figure 9. Prototypes Of the Developed System

5.Conclusion and Future Enhancements

Overall, the result indicates the ability for an evolution of a system which can detect Tsunami in advance based on the pressure changes under the sea. If, it is being practically implemented with the future enhancement any natural disaster can be detected in advance without producing false alarms.

Existing system has all the facilities to detect Tsunami. Obviously it will detect Tsunami before many hours which are going to occur by raising an alarm. But, the problem with the existing system is, there is a chance to produce false alarms often which threatens our government and public. So, in future Tsunami occurrence can be decided and alarm can be raised only after checking many criteria. Four criteria to be checked out are as follows:

- Pressure inside the sea bed.
- Tide level.
- Biological changes in the marine living organisms.
- Sea shore level.

If all these four criteriaget detected then it can be concluded that there is some occurrence of natural disaster (Tsunami).

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