

FIRST STAGE

Step I: Making of the transducer

The transducer is a simple monostable multivibrator[3] made using a 555 timer. The main reason behind this is that it gives us a high output on the application of a low triggering at the triggering pin generating a signal when the water level(in contact with the ground pin) comes in contact with the trigger pin. Such a transducer has been used for 3 reasons-

1. To complete a circuit mechanically whenever any disaster befalls [here flood].
2. Its capacity to amplify weak signals.
3. Ability to keep o/p pulse on for desired time even if the mechanical triggering is instantaneous.)

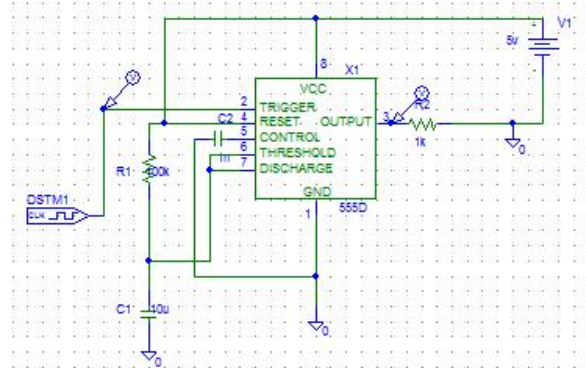


Fig-II monostable multivibrator



Fig-III output waveform

Here the underlying principle is that when the threshold limit exceeds then the trigger is applied and the monostable gives us a high output enabling us to run various circuits.

Here we have taken three distinct levels which will give us three distinct information i.e. signals of the respective levels.

Signal 1: Danger level nearly reached.

Signal 2: Danger level reached.

Signal 3: Danger level crossed.

Step II: Analyzing the generated signals from the transducer.

The analyzing procedure requires a microcontroller. We have used Arduino-Uno as our microcontroller. The signals generated from the transducer will be fed into the Arduino. By identifying the signals it will perform three functions. The first function will be to extract the .wav files from the SD card

and channelizing it to a loudspeaker through an audio amplifier. The second function will be to send an SMS to the person carrying cell phones in the vicinity. The third function is to generate three distinct information for the transmission into the second stage for their identification. The information are $I_1 - (1000)$, $I_2 - (1100)$ and $I_3 - (1110)$. Through suitable program we have been able to perform the above functions.

Output of the various signals according to the signals generated from the transducer.

Signal1 - Danger level nearly reached

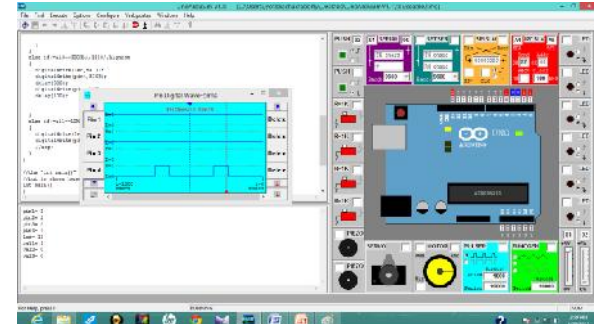


Fig - IV signal1

Signal2 - Danger level reached

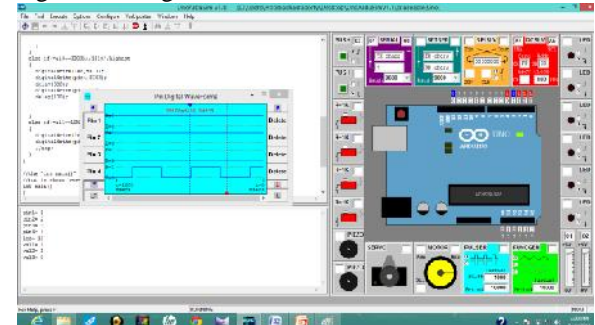


Fig - V signal2

Signal3 - Danger level crossed

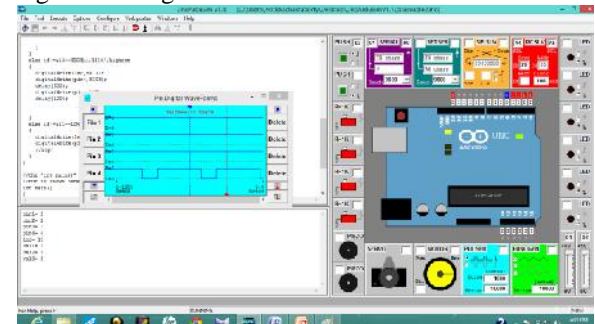


Fig - VI signal3

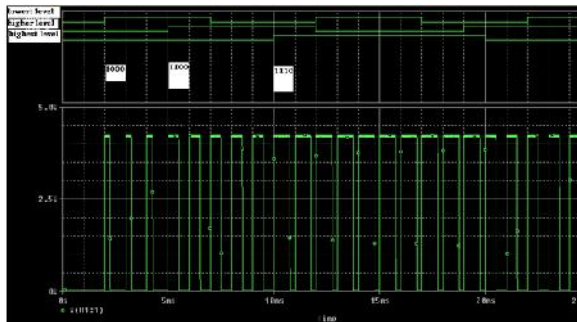


Fig VII - data according to transducer priority

Step III: Arduino- SIM900[5] Module Interfacing

The Tx – Rx ports in the Arduino is connected to the Rx – Tx ports of the SIM-900 module respectively, so as to get a clear transfer of information from the either of the devices’ Tx-Rx ports. The required program is written and loaded to both of the devices which is ready to send different information at the crucial time.

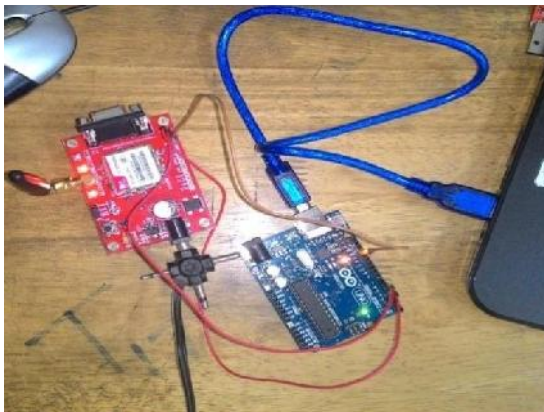


Fig - VIII Arduino – SIM900 interfacing

STEP IV: Arduino –μSD card[6]Module interfacing

The four pins of the μSD card are MOSI, MISO, SCK and CS apart from 3.3V and Gnd supply. The above pins are connected to the pins 11, 12, 13 and 10 respectively, along with the connections of the 5V and gnd. The program written in the Arduino scans the .wav files from the μSD card and channels it to the loudspeaker for PA system.

- 1 -> 3.3v
- 2 -> gnd
- 3 -> miso (12)
- 4 -> mosi (11)
- 5 -> sck (13)
- 6 -> cs (10)

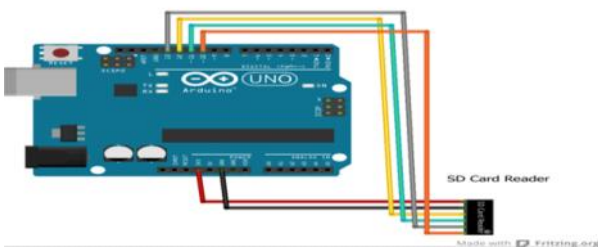


Fig – IX Arduino μSD card module interfacing

STEP V: Data modulation through ASK modulator.

The three data generated in step-II along with the clock signal is fed into the ASK modulator circuit. The ASK modulator carries our digital data to a distant second stage where these

signals can be demodulated and the required data can be obtained for further processing. ASK[7] stands for **A**mplitude **S**hift **K**eying. In this method the digital message is modulated with a carrier frequency to provide us with a modulated waveform. When the message bit is '1' then the carrier is high and when the bit is '0' then the carrier tends to a lower amplitude.

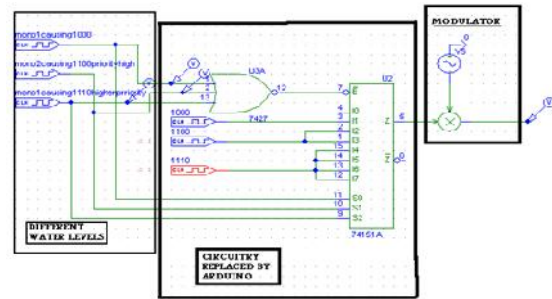


Fig - X ASK modulator in PSPICE schematics

Output waveform in schematics

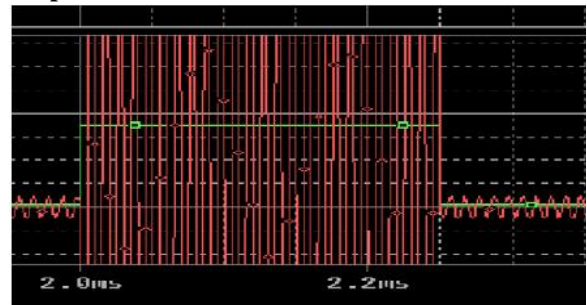


Fig - XI modulated waveform

Practical Results of ASK modulation



Fig - XII Data I₁(1000)

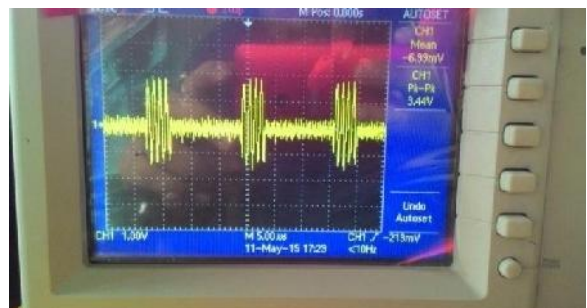


Fig - XIII Modulated Waveform 1(1000)

Similarly the modulated waveform of data I₂(1100) and I₃(1110) have also been obtained. These modulated waveforms are now ready for transmission for the second stage.

SECOND STAGE

The first stage being the nearest transmitter-receiver-speaker system to the transducers, it is the first stage to encode and transmit the data provided by the transducers.

All the rest transmitter-receiver-speaker sets that will be spread around and away from the points of disaster detection will henceforth be called as 2nd stages.

The second stages will receive the information transmitted by the 1st stage or nearby other second stages and convert it to corresponding voice signals(to be spoken as warning through the speaker), to corresponding electric pulses(used to drive a module that might inform the authorities) and retransmit the information again to be caught by other second stages further away.

The transmitter section is same as of the first stage using ask modulation.

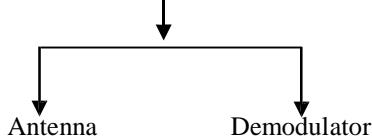
The receiver part can be a coherent correlator of ASK (to demodulate it) followed by a decision device or non-coherent detector(that is, a low pass filter followed by an envelope detector).

Sim900 module can be used to send text to concerned authorities. Arduino-Uno is used as the microcontroller. The external-SD card module can be used to store the audio files.

Step I: The Receiver System:

The receiver section primarily contains two parts.

RECEIVER



The antenna can be replaced by wire i.e. wired transmission is also possible in this case if seemed fit. The antenna used here is able to receive and transmit 960khz to 1.4Mhz.

The Demodulator can be accomplished using either of the two methodologies.

1. Coherent method.
2. Non-Coherent method.

Coherent method will consist of –

- a) Multiplier.
- b) An integrate and dump filter.
- c) A decision device.

as given in the block diagram.

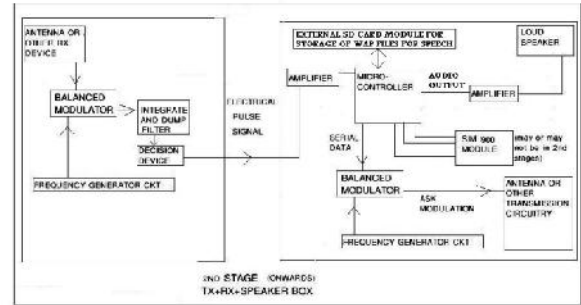


Fig - XIV Coherent detector demodulation

Non-coherent detector will consist of –

- a) A band pass/low pass filter.
- b) An envelope detector.

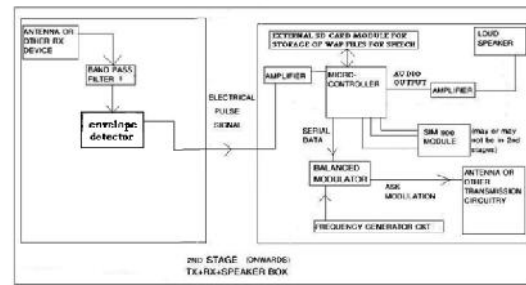


Fig - XV Non-coherent detector demodulation

Output of the envelope detector will generate the same serial data as the as generated and transmitted as message signal by the first stage.

The ASK modulation-demodulation can be shown by PSPICE[8].

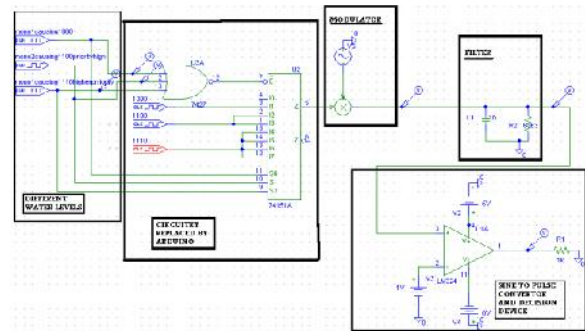


Fig - XVI Modulation-Demodulation technique

The modulator block shows modulation and the last two blocks show non-coherent demodulation of ASK. Thus providing us with the valid input information.

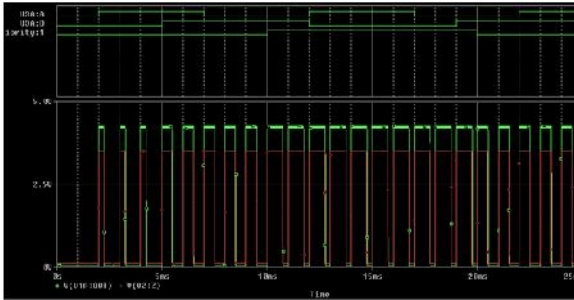


Fig - XVII Input vs. Demodulated output
Green - Input ; Red - Output

Practical results for demodulation

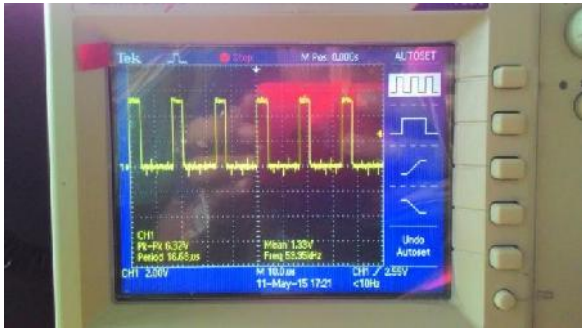


Fig - XVIII Demodulated output(1000)

Similarly the demodulated outputs can be obtained for the respective modulated information I_2 and I_3 .

The demodulated data thus obtained can be analyzed by the micro-controller i.e. Arduino for further processing.

Step II: Analyzing the **Data** from the Receiver[7]

The regained data from the receiver is fed into the Arduino which analyzes these signals and performs functions similar to that of the Arduino of the first stage. Through suitable program the required function is achieved.

Simulation output

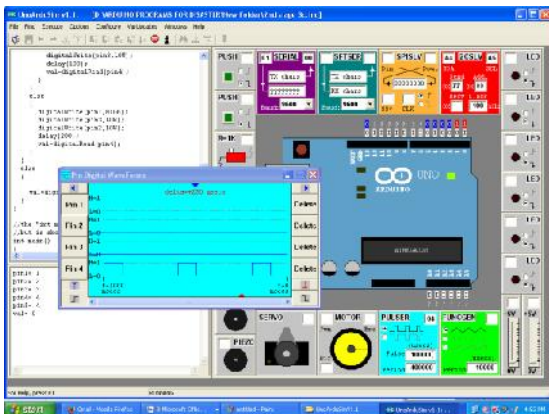


Fig - XIX Serial data(1000) making pin1 on

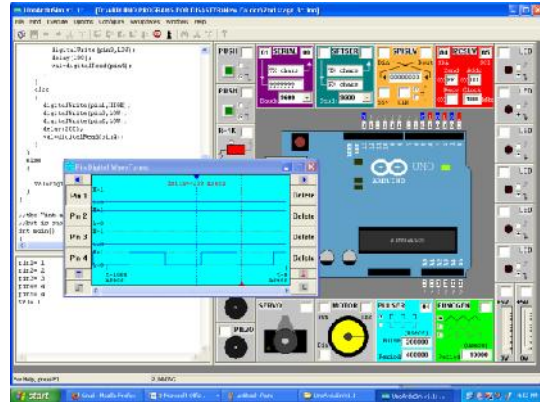


Fig - XX Serial data(1100) making pin2 on

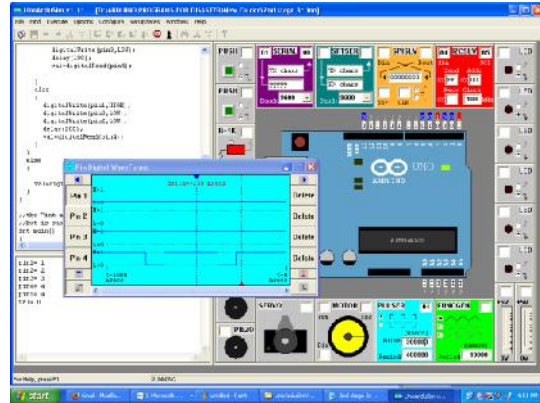


Fig - XXI Serial data(1110) making pin3 on

Practical output results

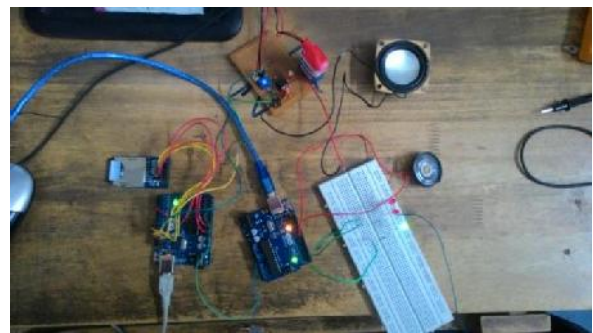


Fig - XXII Serial data(1000) making pin1 on

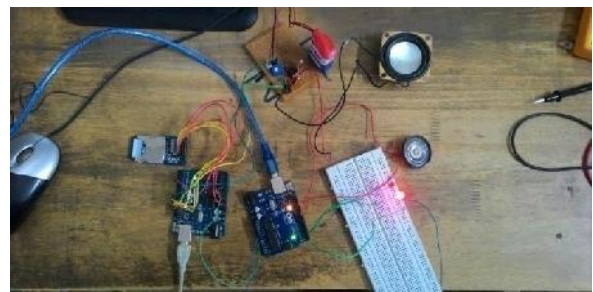


Fig - XXIII Serial data(1100) making pin2 on

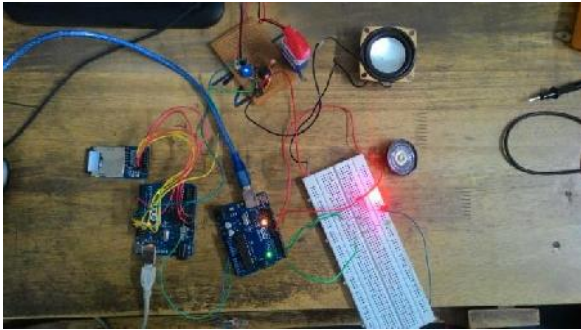


Fig - XXIV Serial data(1110) making pin3 on

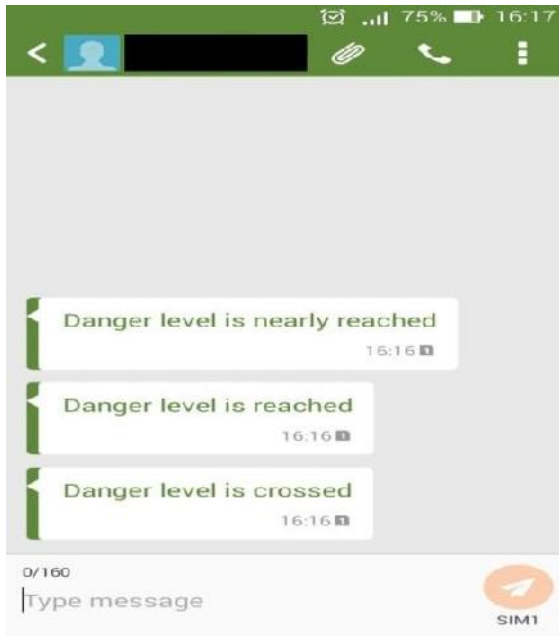


Fig - XXV Screenshot of cellphone

IV. CONCLUSION

The main aim was to create a general system that can be applied to instantly alert large vicinity (as well as authorities). With slight modifications this circuit can be applied for various types of disasters. Including those disasters that will wipe out the transducer or even the nearer stages (on occurring for instance **tsunami**[2] or **landslide**). In such cases the subsequent stages will carry on with the information and thereby alerting people.

*Monostable multivibrator transducer being able to generate a pulse due to even instantaneous mechanical completion of circuitry can be used to **detect seismic activity**[2] too but can't separate between normal seismic and volcanic activity.*

Congestion problem[2] of mobile network have been **solved by applying diversity**. As many stages will have GSM modules sending information to authorities and as the inter-stage information transfer occurs by radio AM process so probability of message being send increases.

The public awareness system is also intensified by using loud speakers at every stage-box.

As we are sending three or more levels of alert for each type of disaster hence **any anomaly in the expected order of such levelswill help us to debug false alerting**[2] .(for example if “danger level crossed “ is triggered before “danger level nearly reached “is triggered then clearly it’s an anomaly.)

V. REFERENCES

- [1] “Design of Real Time Early Response Systems for Natural Disaster Management Based On Automation and Control Technologies” C. Pacheco, A. Cipriano. International Journal of Computer, Control, Quantum and Information Engineering Vol.:9, No:3, 2015
- [2] Natural Disaster Alertness System using GSM network International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 9, September – 2013
- [3] NE555, Single Bipolar Timer, Texas Instruments
- [4] List of natural disasters by deathtoll[http://en.wikipedia.org/wiki/List_of_naturaldisasters_by_death_toll]
- [5] www.circuitstoday.com/interface-gsm-module-with-arduino
- [6] <https://learn.adafruit.com/adafruit-micro-sd-breakout-board-cardtutorial>
- [7] Modern Digital and Analog Communication Systems THIRD EDITION **B.P.Lathi**
- [8] Orcad PSPICE Schematics

About the Authors

Shreedeep Gangopadhyay is an Assistant Professor of Techno India. His research interests are Real time embedded System Design using open source micro-controllers, Artificial Intelligence and assistive technology.

Jyotiska Chakraborty is a 4th year B.Tech ECE student of Techno India. His interests lie in the field of Bionics and Brain Computer Interface devices.

Kundan Chatterjee is a 4th year B.tech ECE student of Techno India. His interests lie in RF and Microwave engineering.