MAT JOURNALS

Journal of Electronic Design Engineering
Volume 2 Issue 3

A Survey on Efficient Life Detection System Using Microwave Signal

Swati S. Patil, Komal Todkar, Namrata A. Gandhi, Nilesh M. Verulkar
Department of ENTC, Mauli Group of Institutions, College of Engineering & Technology,
Shegaon, Maharashtra, India
E-mail: nileshverulkar@gmail.com

Abstract

Thousands of persons killed as a reason behind earthquake. The on top of words is not the headlines of the newspaper, however, such news come back once the disaster destroyed the sector. The disaster within the big apple town at 'World Trade Center' claimed lives of quite 5000 individuals. It absolutely was aforementioned if survivors have been found and rescue earlier the numbers of victims are lower. There is without stopping to the amount of lives lost because the results of such disasters as landslides, folded tunnels and avalanches. The microwave life detection system is developed for the search and rescue of victims at bay underneath the dust of folded building throughout the earthquake or different disasters. The projected system utilizes L-band frequency that is ready to notice metabolic process and heart fluctuations. The operation principle relies on physicist frequency shift of the radiation mirrored from the buried victim. The schematic diagram of microwave Transmitting/Receiving (T/R) and litter cancellation scheme square measure enclosed during this report. During this report varied components of a microwave life detection system like antenna, directional mechanical device, and splitter has been mentioned. By advent of this technique the planet death rate as a reason behind an earthquake might decrease to larger extent.

Keywords: *Microwave, earthquake, signal, frequency, detection*

INTRODUCTION

A new sensitive microwave life-detection system which might be accustomed find human subjects buried underneath earthquake junk or hidden behind varied barriers has been created. By advent of this method the globe death rate could decrease to bigger extent as massive proportion of death occur attributable to earthquake. This method operational at 1150 mhz or 450 mhz will observe the respiratory and heartbeat signals of human subjects through earthquake junk or a construction barrier of concerning 10-ft thickness.

Need of Life Detection System

Existing ways in which to discover the individual underneath the earthquake rubbish and folded buildings square measure utilization of the dogs, optical devices and acoustic life detectors and, therefore, the rescue automaton [1]. However, the dogs will discover the dead persons and this occupies the dear time which may be utilize to discover a live victims. Also, the optical devices have a restricted variety of degree of freedom, need skilled operators and cannot be employed in inaccessible space. Natural philosophy detectors like geophones square measure straightforward to use, however, they need quiet operating environments, a condition tough to succeed in particularly in crucial things. The Rescue automaton will navigate deep into the rubbish to go looking for victim by the employment of temperature detector, however, they are unable to entice once they are going out of vary. Info regarding the placement of buried person would be of nice worth for the rescue personnel, since it would facilitate to cut back the

time of operation and, therefore, facilitate to avoid wasting additional lives.

Principle of Life Detection System

The principle of detection is first, microwave is shipped through rubbish to notice very important signs of life. Microwave has the property to penetrate through barriers and would replicate back from some objects. These objects embody humans. Once the beam hits the body, the signal mirrored with an extra modulation created by movement of heart and lungs [2]. So, the reception of modulated signals shows the presence of alive human within the rubbish. With the modulated signal there are some signal (commonly referred to as muddle signal) that are mirrored from the immobile object like rubbish or trash. So, as to take care of a high sensitivity for this application, the muddle wave mirrored from the rubbish or the surface of the bottom should be off as totally as attainable. For this associate degree automatic muddle cancellation system is employed. This method detects the body oscillations occur due the respiration and heartbeat fluctuations. The system includes the extra scheme to cancel the unwanted signals receive from the inactive objects like rubbish.

Frequency Bands

The microwave life detection system can work on different range of frequencies from Lb and (2GHz) to X- band (10GHz). But X- band microwave is unable to penetrate deep into the rubble. It can penetrate rubble up to 1.5 ft in the thickness (5 layers of bricks) while Lb and can penetrate the rubble of about 3 ft in thickness (10 layers of bricks). Due to the fact that lower frequency will be more capable of detecting vital signs through very thick rubble so frequency of an electromagnetic wave needs to be in the L-band or S-band range, For this reason, the a microwave life detection system which operates on the L-band frequency. This system is supposed to quite efficient to trap the breathing and heartbeat signals of victims who are completely trapped and too weak to respond.

Working Frequency

The frequency of the microwave falls under two categories, depending on the type and nature of the collapsed building. They are:

1. L (or) S band frequency says 1150 MHz.
2. UHF band frequency says 450 MHz.

An electromagnetic wave of 450 MHz is difficult to penetrate layers of reinforced concrete slabs with imbedded metallic wire of 4-in spacing. Through a series of experiment, we selected the operating frequency of 1150 MHz for the second system with the goal of penetrating such earthquake rubble. After the construction of the 450-MHz and the 1150-MHz systems and an extensive series of experiments, we found that an EM wave of 1150 MHz can penetrate rubble with layers of reinforced concrete slabs with metallic wire much easier than that of 450 MHz. However, an EM wave of 450 MHz may penetrate deeper into rubble without metallic wire mesh than that of 1150 MHz. The basic circuit structures of the 450-MHz and the 1150-MHz microwave life-detection systems are quite similar and they are operated based on the same physical principle [3].

METHODOLOGY

The schematic diagram of the 1150-MHz microwave life-detection system is shown .A phase-locked oscillator generates a very stable EM wave at 1150 MHz with an output power of 400mW (25.6 dBm). This wave is fed through a 10-dB directional coupler and a circulator before reaching a radio-frequency (RF) switch, which energized the dual antenna system sequentially [4]. The 10-dB directional coupler branches out one-tenth of the wave (40 mW) which is then divided equally by a 3-dB directional coupler. One output of the 3-dB directional coupler (20 mW) drives the clutter cancellation circuit and the other output (20 mW) serves as a local reference signal for the double-balanced mixer.

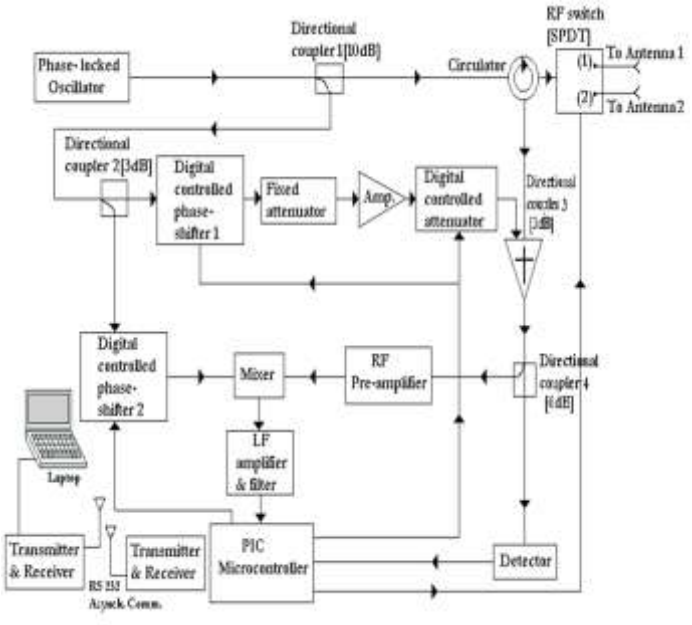

Fig. 1: *Schematic Diagram of the 1150-MHz Microwave Life-Detection System.*

Clutter Cancellation System

The clutter cancellation unit consists of:

1. Programmable Phase Shifter.
2. Programmable Attenuator.
3. A RF Amplifier.
4. Microprocessor Control Unit.

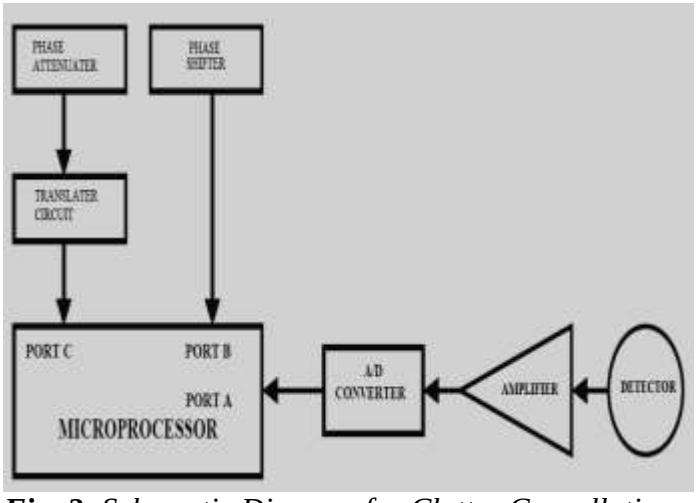

Fig. 2: *Schematic Diagram for Clutter Cancellation System.*

Working of Life Detection System

The clutter cancellation circuit consists of a digitally controlled phase-shifter (0–360), a fixed attenuator (4 dB), a RF amplifier (20 dB), and a digitally controlled attenuator (0–30 dB). The output of the clutter cancellation circuit is automatically adjusted to be of equal amplitude and opposite phase as that of the clutter from the rubble. Thus, when the output of the clutter cancellation circuit is combined with the received signal from the antenna, via the circulator, in a 3-dB directional coupler, the large clutter from the rubble is completely cancelled, and the output of the 3-dB directional coupler consists only of the small reflected wave from the subject's body [5]. This output of the 3-dB directional coupler is passed through a 6-dB directional coupler. The 1/4 of this output is amplified by a RF preamplifier (30 dB) and then mixed with a local reference signal in a double-balanced mixer. The other 3/4 of the output is detected by a microwave detector to supply a dc voltage that is the indicator for the degree of the litter cancellation. Once the settings of the digitally controlled phase-shifter and electrical device square measure swept by the microchip system, the output of the microwave detector varies consequently. The minimum detector reading corresponds to the proper settings for the digitally controlled phase-shifter and electrical device. These settings are fastened for subsequent measurements.

ANTENNA SYSTEM

1. Initially, the switch is kept in position 1 (signal is transmitted through the antenna 1).
2. Wait for some predetermined sending time, Ts.
3. Then the switch is thrown to position 2 (signal is received through the Antenna 2).
4. Wait for some predetermined receiving time, Tr.
5. Go to step 1.
6. Repeat the above procedure for some predetermined time, T.

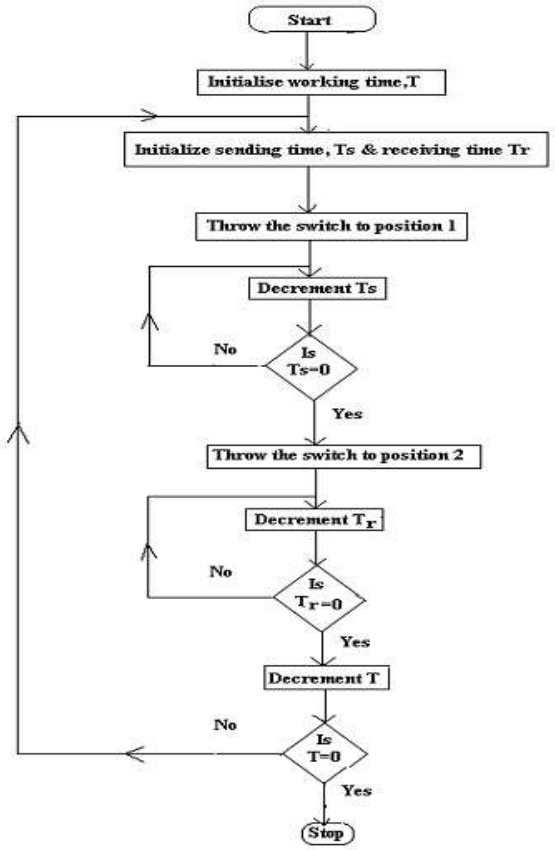

Fig. 3: *Flowchart for Antenna System.*

Demodulation of Clutter Cancelled Signal

1. At the double balanced mixer, the amplified signal of the reflected wave from the person's body is mixed with the local reference signal.
2. The phase of the local reference signal is controlled by another digitally controlled phase shifter 2 for an optimal output from the mixer.
3. The output of the mixer consists of the breathing and heartbeat signals of the human plus some avoidable noise.
4. This output is fed through a low frequency amplifier and a band pass filter (0.4 Hz) before displayed on the monitor.
5. The function of the digitally controlled phase shifter 2 is to control the phase of the local reference signal for the purpose of increasing the system sensitivity.
6. The reflected signal from the person's body after amplification by the pre-amplifier is mixed with the local reference signal in a double balanced mixer.
7. The output of the mixer consists of the breathing and heartbeat signals of the human subject plus unavoidable noise.
8. This output is fed through a low-frequency (LF) amplifier (20–40 dB) and a bandpass filter (0.1–4 Hz) before being displayed on the monitor of a laptop computer.

SYSTEM SENSITIVITY

The function of a digitally controlled phase-shifter (0–180) installed in front of the local reference signal port of the double balanced mixer to control the phase of the local reference signal for the purpose of increasing the system sensitivity is explained below. As mentioned before, the reflected signal from the human subject after amplification by the preamplifier is mixed with the local reference signal in the double-balanced-mixer. The local reference signal is assumed to be ALcos (wt+θL) where AL and θL are the amplitude and the phase, respectively. While the other input to the mixer, the reflected signal from the human subject, is assumed to be AR cos (wt+θE+Δθ(t)) where AR and θE are the amplitude and the phase, respectively, and Δθ(t) is the phase modulation due to the body movement of the human subject. "w" is the angular frequency and "t" is the time. When these two inputs are mixed in the double-balanced mixer, the output of the mixer will be:

$$A_L A_R \cos(\theta_L - \theta_E - \Delta\theta(t)).$$

From this expression of the mixer output, it is easy to see that

If ;

$(\theta_L - \theta_E) = (n+1/2)\pi, n=0,1,2\ldots\ldots$

the system has a maximum sensitivity; (1)

and If ;

$(\theta_L - \theta_E) = \pm n\pi, n=0,1,2\ldots\ldots$

the system has a minimum sensitivity (2),

$\Delta\theta(t)$ is usually a small phase angle perturbation created by the body movement of the human subject. θE is the constant phase associated with the reflected signal from the human subject and it cannot be changed. θL is the phase of the local reference signal and it can be controlled by the digitally controlled phase shifter (0–180).In the operation, the phase-shifter will automatically shift θL in such a way that $(\theta L-\theta E)$ is nearly $(n+1/2)\pi$ to attain a maximum system sensitivity.

CONCLUSION

A new sensitive life-detection system victimisation microwave radiation for locating human subjects buried beneath earthquake dust or hidden behind numerous barriers has been made. This method in operation at 1150 or 450 megacycle will sight the respiratory and heartbeat signals of human subjects through an earthquake dust or a construction barrier of concerning 10-ft thickness. The situation of the person beneath the dust may be glorious by conniving the time lapse between the causing time, Ts and receiving time, Tr. Since it will not be potential to incessantly watch the system beneath crucial things, an alarm has been set, so, whenever, the laptop computer system processes the received signal and identifies that there is an individual's being, the alarm sound starts. The potential defect of this method is that the effects of the background created by the surroundings and operators. A classy signal process theme could more improve the system performance.

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