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Border Security System for Indian Fishermen Using Antenna and Wave Propagation

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Abstract--The above security system uses a microwave antenna operating at a particular frequency band which has been specially allocated for this security purpose. A receiver antenna operating at the same frequency will be receiving the electromagnetic radiations radiated by the transmitted antenna. The base station of the transmitting antenna will be located at Indian soil(For example, in case of border security system for Rameshwaram and Srilanka, a radiating antenna will be at Rameshwaram).The mobile station or receiving antenna will be fixed at the boats on which fishermen travel to acquire fishes. The radiations produced by the transmitting antenna will be radiating power whose strength will be decreasing as the distance between the transmitting antenna and receiving antenna increases. There will be a particular distance at which the radiation becomes unattainable by the receiving antenna. Technically to say, receiver antenna becomes out of line sight or is outside the cell site for establishing communication. This distance is one or two kilometres less than distance between Indian and Srilankan border. Calculation of frequency is made for this particular distance and it is the fixed microwave frequency for communication. Particular microwave is produced and radiated by the parabolic reflector antenna. Antenna at the receiver side is interfaced to the microcontroller circuit. The output of the microcontroller is fed to the loudspeaker. Microcontroller is programmed in such a way that when receiving antenna is no longer receiving the particular frequency radiations, an alarm is triggered on. This alarm is to make fishermen aware that they are about to cross the maritime borders. Since, the alarm is trigerred when fishermen's boat is one or two kilometer less than fixed border line, it will be easy for him to take a detour. Further, the microcontroller when switching on the alarm, makes use of GPS(global positioning system) to send the location of the fishermen's boat which has reached the specified warning line to the nearest coastal guard with a GSM module. For this GSM module, the operating frequency range is different from the previously generated one.
Keywords: Microwave parabolic reflector antenna, GSM Module SIM 900A, DS89C420 microcontroller, PA6C GPS receiver.

I. INTRODUCTION

This particular security system helps in saving the lives of many Indian fishermen who lose their lives because of lack of awareness about the border lines. The proposed idea uses a microwave parabolic reflector antenna to radiate an electromagnetic radiation which uses frequency band unique for this particular communication. The basic working principle is based on the fact that the microwave antenna at the transmitting end when fixed at a particular height, transmits microwave radiations which are received by the receiver antenna. The receiving antenna is a GSM module which operates at the same frequency as that of transmitted radiations. The transmitter and the receiver antenna are said to follow line of sight communication. The line of sight communication is the most suitable one for short distance communication over the range of 30kms. The distance of line of sight communication is mostly dependent on the height of both the transmitter and receiver antenna. The height of the antennas for the corresponding project is discussed later in the paper. Radiations in the range of microwaves are mainly used because it has higher penetration power than other waves. Higher penetration effect means it has higher efficiency in reaching the receiver antenna with a small loss in its radiated energy. A microcontroller is mainly used to perform control operations like triggering alarm on when the defined border level is reached(a distance which is calculated based on UHF or VHF frequencies and the height of transmitting and receiving antenna). After this border level, radiation strength transmitted by antenna will be zero and the receiver will be no longer receiving the radiation. The microcontroller is programmed in such a way that when the signal strength is zero, the loudspeaker interfaced to the microcontroller will be triggered on. Once when alarm is triggered, the location fishermen's boat will be tracked by GPS module and will be sent to the Coastal guard who are in the range of particular communication cell site by using GSM module.

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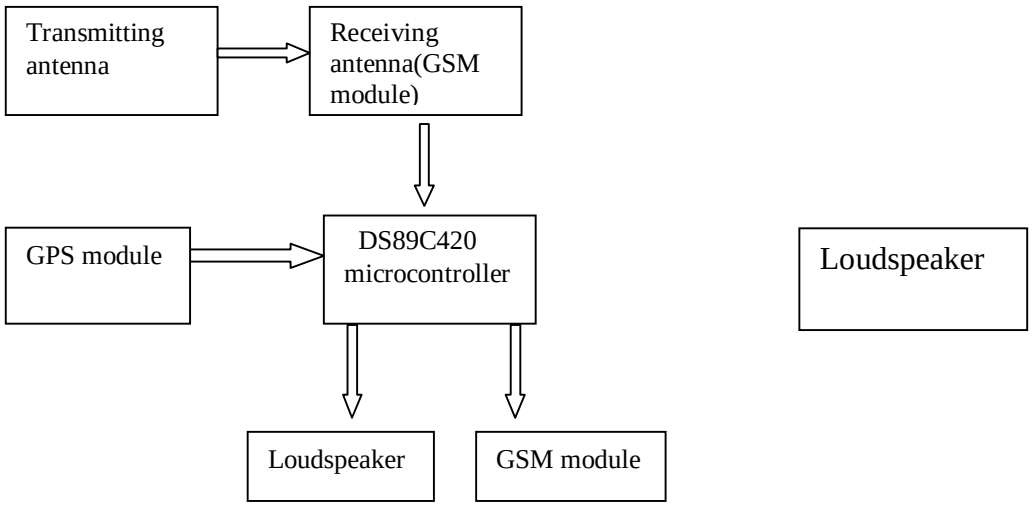
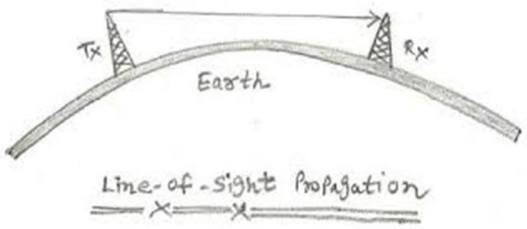
BLOCK DIAGRAM



II. LINE OF SIGHT COMMUNICATION

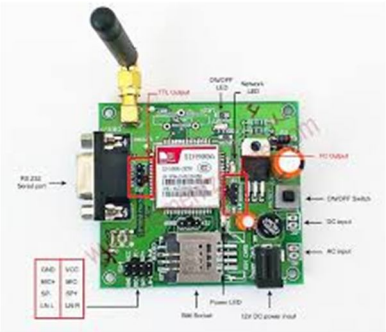


Line of sight communication involves two antennas(transmitter and receiver) placed within their line of sight. This type of communication is mostly used for transmitting the radiations within a kilometer range spanning from 25-30kms. It has lot of disadvantages like the energy of the signal getting reduced by the absorption of radiations by buildings, undergoing reflection from earth surface and refraction etc. But, in the case of sea the radiations undergoing losses are less in comparison with urban areas. The main reason is there are no buildings or any other medium which absorbs the radiation. But, the atmospheric conditions and wind may lead to the diffraction of radiations which may attenuate the energy of the radiation. Hence, an antenna with high gain and directivity has to be used to withstand the above losses. For example, it is a case that the distance between Dhanushkodi and Srilanka border is 29 kilometer. We are fixing a frequency band of microwave UHF band frequencies such that the transmitting antenna is fixed at the height of 10 meters(30 feet from the ground) and receiving antenna is fixed at the height of 2 meters(6 feet from the base of boat). Two antennas follow a line of sight communication with radiations accounting for a distance of radius 19 km (approx). Due to various losses, signal strength may become totally zero at the distance of 17 km or less. So, fishermen travelling from Dhanushkodi may travel a distance maximum of 19 km and an alarm will be triggered on forwarding the location of fishermen boat to the nearest coastguard agent.

III.TRANSMITTING ANTENNA

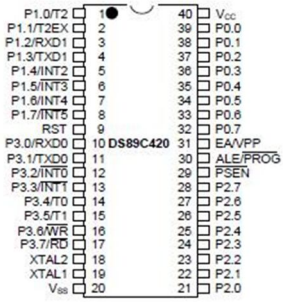
The transmitting antenna is the base station which is used for generating radiations whose frequency is unique for this application. Usually, parabolic reflector antenna is used as a transmitting antenna because, it has high directivity. It is high gain antenna for line of sight or point to point communication. Moreover, it uses cassegrain feed which hinders the radiations escaping through the back lobe. The height of the antenna fixed from the ground plays a major role in the distance of coverage for the communication. Usually, the transmitting antenna are fixed at the height of about 30 feet to cover maximum distance. Since, it is a high gain it is highly resistant to the divergence of radiations. Moreover, the antenna radiations which have unique frequencies for this communication does not depend upon the handover and frequency reuse factors.

IV. RECEIVING ANTENNA



The receiving antenna is a GSM module with an unique identification number and the frequency band which is same as that of transmitting antenna. The module used here receives the signal efficiently from the base station and the signal strength goes on decreasing as the distance between two antenna increases. At one particular distance, the total radiated energy becomes zero and radiations are not received by the GSM module. GSM module is interfaced to DS89C240 microcontroller(rx pin of module to any output digital pin of controller). Microcontroller checks the radiation availability from the transmitting antenna and when no radiations are received, loudspeaker coupled to the output pin of microcontroller will be triggered on.

V. MICROCONTROLLER



DS89C420 is a high speed flash microcontroller which is compatible with 8051 microcontroller. One of the advantage of above microcontroller is it consists of two serial input/output peripheral ports. It means that we can interface two serial data devices to the microcontroller. It has 16 digital data input/output ports. For the above project, the receiving antenna(GSM module's) output ports are connected as an input to the port 1.2,port 1.3 of microcontroller. Based on the programming commands, when receiver is no longer receiving the radiations, the microcontroller switches on the alarm. The alarm source is a loudspeaker which is interfaced to any one of the 16 i/o ports.The other set of serial i/o ports are connected to the GPS module,which tracks the position of the boat. The calculated location data is serially written to another GSM module which is operating at the different frequency from the previously transmitted radiations which are no longer received. For this purpose, RX,TX ports of GSM module are connected to the WR/RD of microcontroller(port 3.6,3.7).

VI. GPS MODULE

Global positioning system is the one which is satellite based navigation system which provides person's particular location and time irrespective of the weather conditions in that particular location. The module used here is PA6C gps receiver. GPS modules are the receiving modules which receives the information about its location by using the satellites in the space. The location of the user is transferred as a serial data to the GSM module. The main aim of this process is to forward the location of the receiver to the coastal guards present within the range of communications. This process makes sure that whenever the alarm is triggered on, the coastal guards nearer to the fisherman's boat will be informed about the warning and their location can be used by the guards to protect them from any mishaps.

VII. SOFTWARE TOOLS

Keil development tools to program the microcontroller.

VIII. RESULTS

The result of the above project is an alarm ringing sound produced by the loudspeaker which is connected to the output port of microcontroller.(i.e this happens when the receiver antenna becomes out of range from the cell site of transmitting antenna)
The location of the fishermen is tracked by the GPS module and sent to the GSM module which then transmits the location as a message to the nearest coast guard officers and an alert message to protect them.

IX. ADVANTAGES

Saves the lives of many million Indian fishermen who are lose their lives of border conflicts.
No human intervention is needed.
It is a viable process.

X. DISADVANTAGES

Spectrum allocations which are unique to conventional ones are needed which makes this process a costly one.

XI. FUTURE ENHANCEMENTS

The above idea can be further enhanced by switching off the ignition system of the boat or stopping the rotation of motor fixed to the boat.
The control operation is performed by the microcontroller sending electric signals to the corresponding systems when loudspeaker switches on.
This enhancement needs a lot of research on ignition system of the boats and the motor fixed to it. Hence, the above operations can be used for future enhancements of the project.

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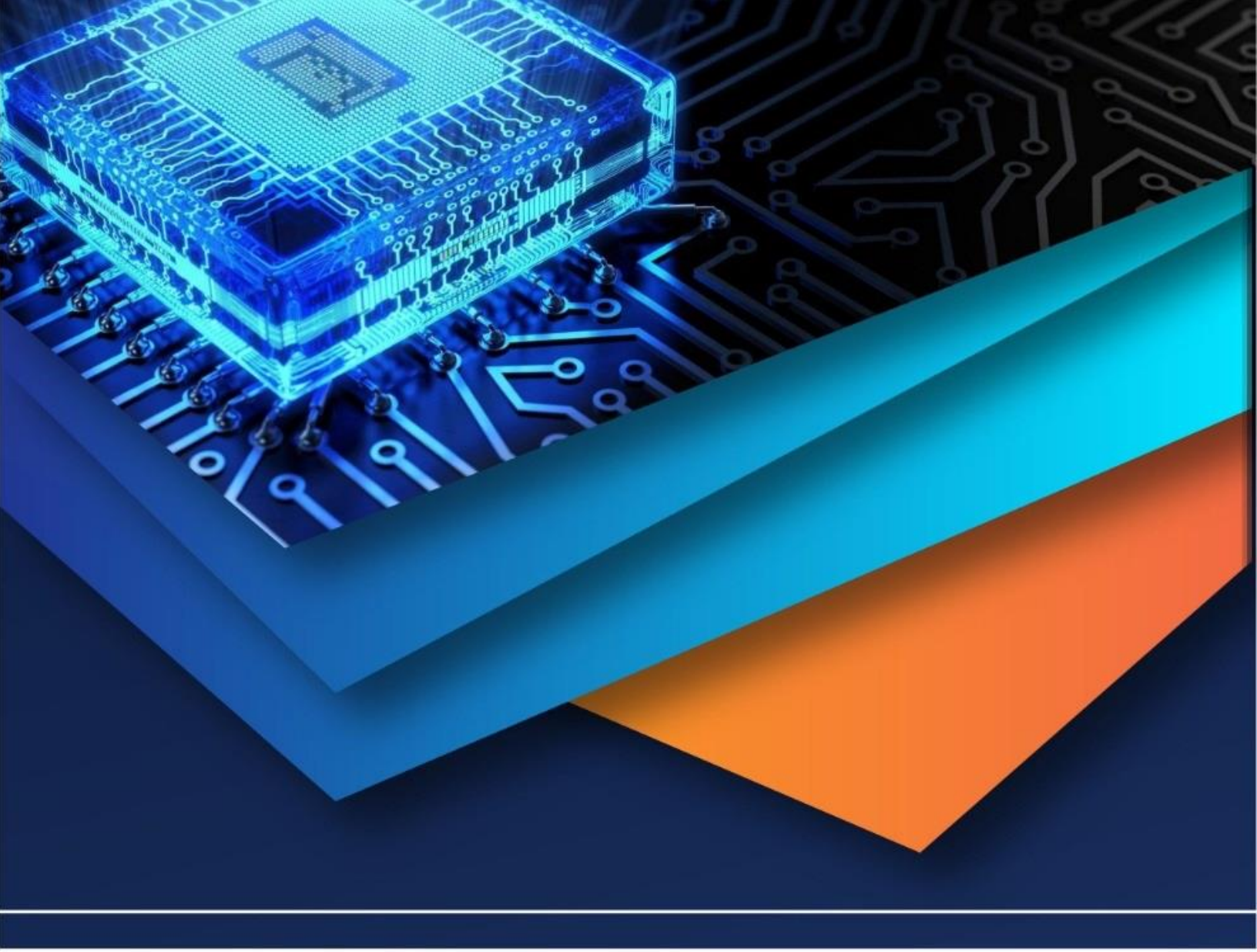

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