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Laser Wall: Possibilities and Scope in Indian Defense System

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Abstract: For the LASER wall installation in Indian defense system we have to think about its geographical area and variations in climate across the country. As we know that some places are too hot in the summer (above 49°C) and some places are too cold in winter (below -50°C) [1]. So it is difficult for surveillance and patrol lining. At those places, we can use an electronic wall which gives protection and surveillance from unauthorized entry. Laser wall technology consists of three major part e.g. LASER, Infrared Camera, and GPS system. An optoelectronic sensor is used to detect Laser beam through which a microcontroller regularly maintain a proper voltage level. If anyone crosses that laser beam light then there is a disruption in voltage level and microcontroller generate a signal which is transmitted through GPS system and that warning signal being sent to the base camp station, thermal images of the particular area are also sent through GPS system simultaneously. Since each microcontroller may hold a unique ID of that particular location through which it can be easily identified by that location.

Keywords: LASER, Infrared Camera, GPS System, Microcontroller.

I. INTRODUCTION

India's border runs a total length of about 15,106km. Its western border runs about 3,323km with Pakistan which is divided along the boundaries of Thar, Punjab, region and Rann of kachch[2]. This border is also along the Indian state; Gujrat, Rajasthan, Punjab and Jammu & Kashmir. Both of nation set out a Line of Control [3] to serve as the informal boundary between Indian and Pakistan-administered areas of Jammu & Kashmir. India's border with Bangladesh is about 4,06km [1]. Mizoram, Tripura, Meghalaya, Assam and West Bengal are the states which share a border with Bangladesh. The line of Actual Control is the functional border between India and China. It covers about 4,057km along with Indian state of J&K, Utrakhand, Arunachal Pradesh, Sikkim, and Himachal Pradesh. The border with Bhutan runs along 1,643km and with Nepal, it covers about 1,757km and with Myanmar, it covers about 1,643km [1]. The Thar desert forms a significant area of western India along with about 700km²[1]. Annual temperature can range from 0°C (32°F) in winter to above 50°C (122°F) during summer [1]. The Siachen Glacier is under the administration of India which covers around 700km². At this point, two countries post are also situated one side Pakistan army and another side China army. The average winter snowfall is more than 35ft and temperature can fall to -50°C.

Thus we have an overview of the geographical area of our country and we have come to the point that some part of border area whether it is the Thar Desert or Siachein Glacier, it is not possible these areas to surveillance under normal condition. If we have to do it then we have to pay a huge amount on the basis of many soldier's life. So there is one way to resolve this problem by electronics devices e.g. Laser [4]. The laser has one thing which made it unique i.e. its directionality, monochromaticity, and coherent light. Although the Laser is of great interest in optoelectronics. The basic mechanism of light emission from a laser is the same as that from a light emitting diode. However, in contrast to the incoherent light of light emitting diodes, laser light has spatial and temporal coherence. The spatial coherence means that the two fields at two different points of a wavefront of a given radiation have a constant phase difference. This result, in a highly directional beam of light. On the other hand, temporal coherence means that, at any point of space, the wave amplitude varies sinusoidally with time. This shows that emitted radiation is monochromatic. The second thing which makes this technology more advanced is Infrared Camera [5]. As we know that all animals radiate infrared waves in the form of heat that waves can easily detect by an infrared camera. Generally, the Infrared camera is a thermographic camera [6]. Infrared energy is nothing but electromagnetic spectrum[7]. All objects emit a certain amount of black body radiation as a function of their temperature. If the objects are a higher temperature then it radiates higher infrared rays as black body radiation. Infrared cameras can easily work in darkness as the intensity of light does not matter. As in

the ordinary camera, there is used of glass but one major difference with an optical camera and an infrared camera is that in the place of glass, germanium or sapphire crystal must be used as glass blocks long-wave infrared light[8]. The third and most important thing of this technology is GPS (Global Positioning System) system [9].GPS works in any weather conditions, anywhere in the world. The first and most obvious application of any location based service. GPS helps you determining where you are, but sometimes it is more necessary to know how to get somewhere also. GPS used in conjunction with communication links and computers can provide the backbone for systems tailored to application in public safety, vessel and vehicle tracking. Mapping the planet has never been an easy task, but GPS today is being used to survey and map it precisely, saving time and money in this most stringent of all application. GPS can help to generate maps and models of everything in the world, mountains, sea, rivers, cities, etc.

II System Model

System model gives us a basic idea of laser wall technology i.e. How it work.It means we can describe it the help block diagram.

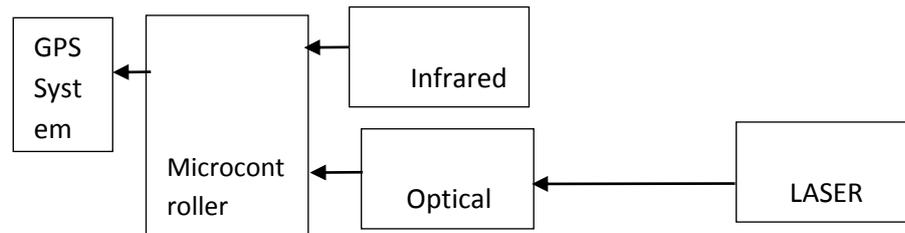


Figure1: Basic Block Diagram of LASER Wall Technology

Laser wall technology [10] consist of basic six element Example-optoelectronic device optical sensor, microcontroller, infrared camera GPS SYSTEM.

From the above block diagram, we can easily under Stand that how laser technology work it In the above fig. we can see that an optoelectric device is used, For the purpose of the optoelectric device, LASER is the best suitable device because it has directionality coherent and monochromatic light radiation. The light which is emitted from optoelectronic device e.g. Laser has collected by the optical sensor. For optical sensor PIN diode [11] can be used. This optical sensor device e.g. PIN diode is connected with microcontroller [12] which maintain a proper voltage level. Along with an infrared camera is also connected to a microcontroller which captures thermal images. When there is an interruption in light then there is a change in voltage level which is maintained by the microcontroller. The microcontroller takes this interruption of light as an interrupt. The microcontroller then works according to this interrupt and gives the signal to GPS system to send thermal images of that particular location so that we can easily detect that there is someone who crosses laser fence.

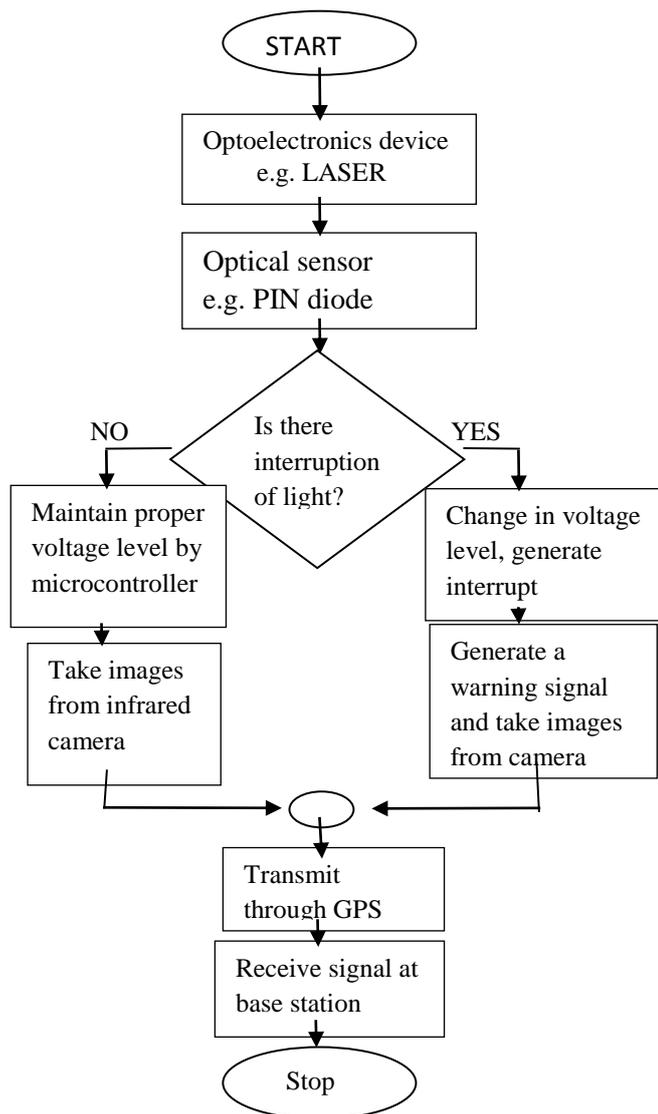
Now we explain each section of block diagram through which we can easily understand the operation and working of laser wall technology. First of all, we take laser diode as optoelectronics device. Basically, the laser diode is based on the principle of stimulated emission. From the term stimulated emission we can understand that when a photon having an energy level interacts with the atom in the higher energy state causing it to return energy state with the creation of the second photon. Both the photons happen to be in phase and have the same polarization and hence amplitudes are added up or energy increased which is called light amplification. Light amplification in laser occurs when a photon colliding with an atom in the excited state causes stimulated emission of a second photon and then both these photons released two more continuous of this process creates avalanche multiplication and when electromagnets wave associated with these photons are in phase, amplified coherent emission is obtained. The laser does not consist of a single wavelength, rather a series of wavelength peaks corresponding to different longitudinal modes within the structure.

The spacing of these modes depends upon the optical cavity length as each one corresponds to integral numbers of lengths. They are generally separated by a few tenths of nm and laser is said to be a multimode device. But here we take only single mode operation. In a single mode operation, the optical output is restricted only to a single longitudinal and single transverse mode. Therefore, the spectral width of emission from a single mode device is much less than broadened transition line width.Now second of the most important component in this technology is an optical detector. The basic detection process can be explained as when a photon incident in or near the depletion region of this devices which has an energy $h\nu \geq E_g$ of the fabricating material will excite an electron-hole pair so generated near the junction are separated and swept (drift) under influence of the external circuit in excess of the reverse leakage current. PIN photodiode is used when operating in the $0.8\mu\text{m}$ to $0.9\mu\text{m}$ [13] band requires a depletion layer of $20\text{-}50\mu\text{m}$ [14] in order to attain higher quantum efficiency (85%) together with fast response ($<1\text{ns}$) and low dark current($<1\text{nA}$)[15].

Now we discussed infrared camera. Since the infrared camera is also called thermal images camera. As the name suggest that thermal images i.e. each human being radiate heat in the form of infrared waves. This radiated wave can be captured by the infrared camera.

In this technology, we use AVR microcontroller [16]. But here the question arises that why we use AVR microcontroller? The reason is that if there are some peripheral is added then both changing the input level can generate an interrupt. There is added an EEPROM to store data over a power off time. An internal oscillator and an internal power-on reset make the AVR working without any other components. The cycle time is reduced from 12 to one so instruction time is many times faster than 8051[17].

The detail function of laser wall technology which we explained above can be easily described by following a flow chart.



(Figure 2: Flow chart diagram of operation)

III. Possibilities and Future Scope

As we know that geographical area of India is not similar. Somewhere is the hottest desert and somewhere is a coldest glacier. If we talk about western boundaries of India then we have analyzed that its boundary is connected with Pakistan from long distance with desert. The temperature of this desert area rises above 50°C in summer and dust storm in the month of May & June. Therefore patrolling and surveillance is not possible for Border Security force. As we have come to know from the news that BSF person got to sleep for only four hour due to high duty of patrolling. Force, a national security, and aerospace newsmagazine published a report in which a senior Indian Police Service officer and inspector general in the Bureau of police research and development (BPR&D) Manoj Chhabra conducted the study [18]. In this report throws light on the state and fitness of BSF troopers, who guard two of most crucial Indian frontiers along Pakistan and Bangladesh.

A force report says that inadequate sleep, harsh, abusive and sadistic seniors and a constant fear that even genuine errors would be treated as negligible of duty and invite punishment- such is a lot of our Border Security Force soldiers. So it is necessary to think about this issue.

Laser wall will help guard areas where barbed wire fencing cannot be installed due to the treacherous terrain. Satellite-based signal command system used for monitoring the areas. These walls armed with fog operability tolls.

If laser wall has been made operational along the India- Pakistan international border in Punjab to plug the porous riverine and treacherous terrain and keep an effective vigil against intruders and terrorists exploiting the frontier areas to crossover.

If the laser wall or fence are being monitored by BSF which can guard the Indo- Pak border in Jammu and Kashmir, Punjab, Rajasthan, and Gujrat. If we keep in mind the vulnerability of border in the area Rajasthan, Jammu, and Kashmir, Punjab as

barbed wire fencing could not be installed in many infiltration prone areas due to treacherous terrain or marshy riverine topography.

We have come to know from the news in the Times of India dated 27 April 2016, that in Pathankot terror attack, where it was suspected that terrorist crossed over from Pakistan by breaching the border from Barniyal area in Punjab, Government of India spends up the deployment and activation of these walls along the long and winding border.

The India and Pakistan border runs from the Line of control which separates the Indian-controlled Kashmir from Pakistan-controlled Kashmir, in the north to Wagah which partitioned the Indian Punjab state and Punjab province of Pakistan in the east. The zero point separates the Indian states of Gujrat and Rajasthan to Sindh province of Pakistan in the south. Since the independence of India and Pakistan, the border has been a site of numerous conflicts and wars between the two countries and is one of the most complex borders in the world. The border area has regularly seemed attempts at infiltration by terrorists, as well as the smuggling of arms, ammunition, and contraband.

Now, we have to think about what should be its future scope? Is this technology to be a success in India? And many more question.

So, first of all, we have to think about western boundary region. Western India is maximum covered by desert and temperature rises above 50°C with a dust storm. So in this area patrolling and surveillance is not easily possible. Therefore laser wall technology work like a good guard.

Now let we consider about the north hilly area and glacier area. We have come to know from the news that intruders enter in our country from the hilly area where it is not possible to maintain order and security as like as glacier area where the temperature falls below -50°C. In that area, this technology works easily and protect us. We can use this technology in Jammu Kashmir hilly area, Arunachal Pradesh border area, Assam border area.

CONCLUSION

In this paper, we have presented Laser wall technology which is capable of protecting us from intruders and unauthorized entry. This technology may work easily and act likes a guard where it is not easily possible to maintain order and security i.e. riverine area, desert area, glacier area, hilly area. So this technology works like an electronic wall which protects us on behalf of the life of army personnel.

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