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DESIGN OF AUTOMATED BORDER SURVEILLANCE AND FIRING SYSTEM "(SIMA FM)"

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Abstract—*In this paper, a system defines a design of an automated intrusion detection and firing system, SIMA FM (Fire on Motion), which is used for surveillance of borders. Surveillance is a key factor that initiates any security force to act accordingly from the collected data given by the system. In case of border regions, persistence of extreme climatic conditions that are so challenging to deploy personnel, are found. This automated device is designed to be deployed in such region, that uses PIR sensors and a control unit using ATMEGA and also the device is connected to the military base nearby, by wireless connection. Detection is done by sensors that are placed at certain angles to aim the intruder and also the data about the intrusion is sent to the base station as an alert message. The structure of the device is made in such a way, it can persist over the border conditions and also the device remains invisible by the use of retro reflection technology. Any intruder can be detected and terminated using this system by which borders are made more safe and secured.*

Keywords*: Surveillance, ATMEGA microcontroller, PIR sensors, Bluetooth module.*

1. INTRODUCTION

In this project the innovation in the defense system by means of automated surveillance is made possible. This is nothing but a rover type surveillance device which can be installed in the border region thereby increasing national security over border region. The name "SIMA FM" is nothing but Border (SIMA) which is defended by "Fire on Motion" (FM) technology thereby providing a secured border surveillance which ensures automated surveillance is possible. The system is simpler but the concept that has been implemented makes it more secured and efficient. In any surveillance process detecting seems to be the key part in which any problem can be solved or avoided only when that concerned problem is identified. This identification process is done by means of the motion that is sensed by the sensors from the intruder. However a common issue arises, on the factor that if any intruder comes to know about the presence of such device and align their movement accordingly so those aren't noticed by the sensors.

In order to overcome this drawback the device is made in such way that it seems to be invisible from any distance by means of retro reflecting technology which is briefed on the upcoming descriptions. Also a pattern for placing those devices is also followed by which even group intrusion can be stopped or informed about to the base military station by means of text message. By this the concerned troops can arrive on the spot of where the intrusion has been detected. By this automated surveillance and firing system, valuable lives of the soldiers who are undergoing surveillance in such regions are made secured and also instant action is taken as soon as it is detected and also the information about the detected intrusion is provided to the concerned military base station through message.

This paper is organised as follows: The proposed system model and analysis of SIMA FM are discussed in section II. In section III, Characteristics of the system is presented. In section IV, Operation modes of SIMA FM are briefed. In section V, Results and Outputs are discussed and concluding remarks is given in section VI.

2. PROPOSED SYSTEM

A. *Block Diagram:*

The function of the device is fancied under the given block diagram illustrated in Fig. 1.

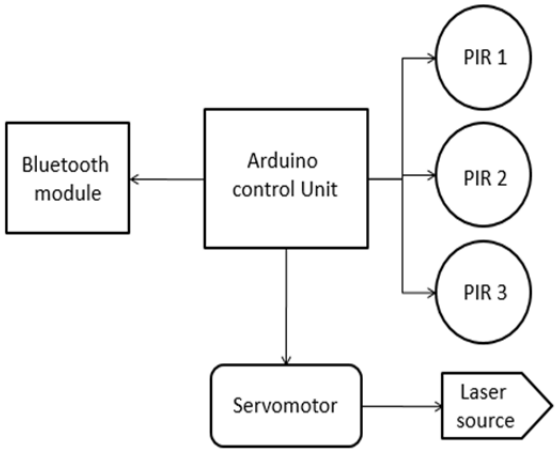

Fig. 1: Block diagram of proposed system

The microcontroller collects data from the input devices i.e. Motion sensors in the system and deploys control for elimination of the intruder and sends the information of intrusion to the nearest Bluetooth device of the user.

B. Need of Automation:

To increase the security of the country by providing an automated surveillance system that can reduce the loss of lives in the border region and also the extreme climatic condition that does not favor deploy of personnel. Unlike other nations, India has life-threatening boundaries. In that case surveillance is done by large number of soldiers every day, provided there is no assurance of safety to their lives. In order to reduce the loss of life, an automated surveillance system has to be replaced in the place of manual security, which ensures security at the borders and to the military men.

C. Placement chart:

As shown in the figure, the SIMA FM device will be placed in the pattern that is mentioned below which is capable of blocking the intrusion even at a massive scale where none of the specimen can escape from the range as shown in Fig. 3.

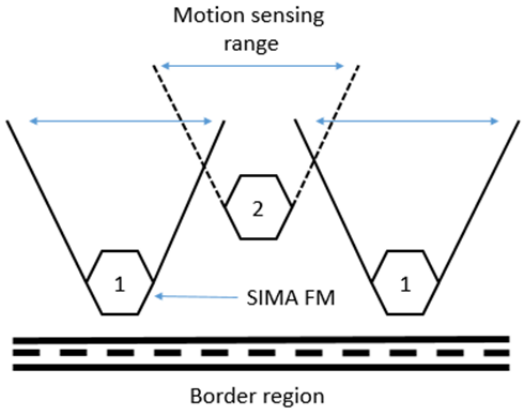

Fig. 3: Placement Chart

3. SYSTEM CHARACTERISTICS

SIMA FM is executed by the use of microcontroller, PIR sensor, Servo Motor, Bluetooth module, Laser pointer.

A) Microcontroller ATMEGA 2560
B) PIR sensor
C) Servo Motor
D) Bluetooth Module
E) Laser pointer

A. Microcontroller:

The high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller combines 256KB ISP flash memory, 8KB SRAM, 4KB EEPROM, 86 general purpose I/O lines, 32 general purpose working registers, real time counter, six flexible timer/counters with compare modes, PWM, 4 USARTs, byte oriented 2-wire serial interface, 16-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. The device achieves a throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves a throughput approaching 1 MIPS per MHz, balancing power consumption and processing speed. Pin diagram of Atmel ATmega 2560 is given in Fig. 2.

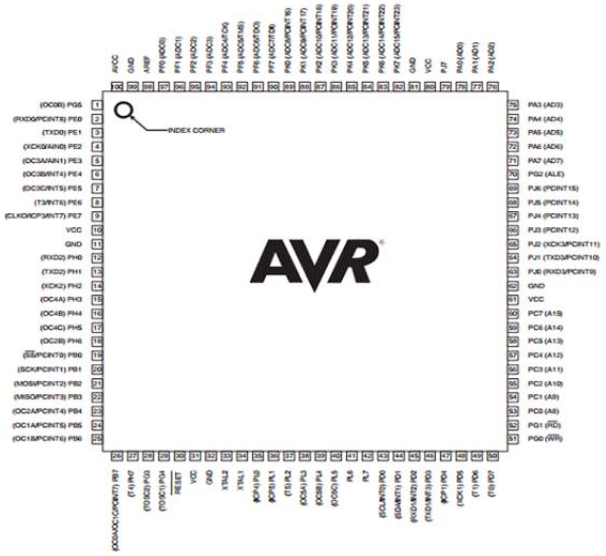

Fig. 2: ATMEGA 2560 – Pin Diagram

B. PIR Sensors:

A passive infrared sensor (Fig. 4) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. A PIR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. They are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector. PIRs come in many configurations for a wide variety of applications. The most common models have numerous Fresnel lenses or mirror segments, an effective range of about ten meters (thirty feet), and a field of view less than 180 degrees. Totally three sensors are utilized in this device.

Fig. 4: PIR Sensor

C. Servomotor:

A servomotor (Fig. 5) is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

Fig. 5: Servo motor

D. Bluetooth Module:

HC-05 (Fig. 6) module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. With this the alert message is sent to the smart phone of the user as soon the intrusion is detected.

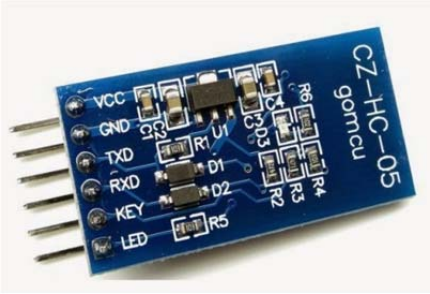

Fig. 6: Bluetooth Module HC-05

E. Laser pointer:

The laser pointer (Fig. 7) is used instead of a weapon for experimental convenience for targeting the intruder. The laser

pointer is a small handheld device with a power source (usually a battery) and a laser diode emitting a very narrow coherent low-powered laser beam of visible light, intended to be used to highlight something of interest by illuminating it with a small bright spot of coloured light. Power is restricted in most jurisdictions not to exceed 5mW.

Fig. 7: Laser Pointer

4. OPERATING PROCESS

Here, we have designed SIMA FM to perform the following functions,

A) Invisibility
B) Detecting motion
C) Target aiming
D) Alert message

A. Invisibility:

In this device the invisibility of the device is made possible by means of the retro reflection technology, which means the entire device is covered with liquid crystal displays all over the outer surface. These displays are interfaced in such a way that a camera that is installed in the device captures the picture of the surrounding environment and then displays it in the screen by which the entire device tends to appear as if the device is not present in the particular place. By this invisibility of the device is made possible and so that the intruder arriving at that region is unaware of the presence of the device and get caught into the range of the device.

B.* Detecting Motion*:

The motion sensing PIR sensors are placed at three different angles towards the left, right and the centre at an angle of 20°, 160° and 90° respectively in the front part of the device so that it is easy for the device to detect the motion of the intruder. Also the motion sensors are connected to the laser pointer and the servomotor by means of the microprocessor to align the functions accordingly. As soon as the sensor detects the motion it sends the data to the control unit from where the other instructions are given for the system.

C. Target aiming:

As mentioned above, the main aim of placing thee sensors at three different angles is to turn the servomotor to the respective angles accordingly by which the laser pointer present on the servomotor also turns and thereby the concerned intrusion that has been detected is targeted and fired. By the placement chart given above it is clear that the intruder can never escape from the range of the device even if the intrusion is in a massive scale. After detecting the intrusion both firing and alert message are given at the same time.

D. Alert message:

In this after the detection of the intrusion the device with the help of the motion sensor concludes the direction and angle from where the intrusion has been detected and then turns the laser pointer towards it thereby to make that as target. As soon as the intrusion is detected an alert message is sent to the smart phone by means of a Bluetooth module, so that the person also gets to know about the intrusion and arrives at that place to examine the situation.

5. RESULT AND DISCUSSIONS

In this device, the obtained results are satisfactory and there are two important things to be mentioned regarding the working of the system.

A) Structural design

B) Functional output

A. Structural Design:

This is the structural design (Fig. 8) given for the device that enables the survival and existence of the device on tough environments without any distraction.

Fig. 8: Side view of SIMA FM

The uplifted structure of the device enables it to detect the motion accurately by the three sensors and aim the target by means of the laser pointer placed on the top of the device (Fig. 9).

Fig. 9: Front view of SIMA FM

B. Functional output:

As shown below in Fig. 10 and Fig. 11, a camera is placed on one side of the device and the image captured is displayed on the other side by means of a liquid crystal display which is described above as retro reflecting technology.

Fig. 10: Camera installed on one side

Fig. 11: Image displayed on other side

6. CONCLUSION

By this any intruder trying to get in the border region is detected and the exact position of it is analysed and then fired. This activity is sent as an alert message as soon as the intrusion is detected. Also the entire outer surface of the device is covered with the liquid crystal displays as a sample screen output is shown above. By this device SIMA FM the security over the border region is increased and defence system is improved.

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