Computer Controlled Intrusion-Detector and Automatic Firing-Unit for Border Security

VENKATAPATHI PALLAM¹, P.BHEERENDRA KUMAR²

Abstract: This paper describes a novel computer-controlled intrusion-detector and automatic firing unit, which may be used for the surveillance of borders, either of a country, or of areas requiring high security, especially in regions of extreme climatic conditions, where it is difficult to deploy personnel. This system not only detects intrusion but also provides a video-coverage of the suspicious area, for remote vigilance, via a satellite based communication system. It is also provided with automatic firing mechanisms which can be used to automatically locate and fire at the target. Thus, several kilometers of the borders, which would have otherwise required several hundred personnel, can be effortlessly monitored with this system, with only a few personnel. Since, the actual firing occurs only after an authoritative personnel has doubly confirmed the presence of an intruder, chances of firing at innocent people are completely ruled out. As thermal cameras are used for imaging, this system is immune to changes in ambient conditions, and therefore, is equally suited for operation during the night. This paper also throws light on the prototype of this system, which has been successfully developed.

Keywords: Automatic Firing Unit, Intrusion Detection, MATLAB, AT Mega, Border Security.

I. INTRODUCTION

Reckoning the increasing security threats, it becomes very necessary to cautiously defend the borders of a country, or of any other areas demanding extreme security. However, owing to the vastness and the extreme climatic conditions which may be prevalent in these regions, it becomes practically impossible to deploy personnel throughout the borders. Hence, the need for an automated device is felt, which can render the efficient guarding of the frontiers, without any compromise on safety. This paper attempts to throw light on the design of a “Computer Controlled Intrusion Detector and Automatic Firing Unit for Border Security” and its features. This system, equipped with Thermal cameras and a Digital Signal Processing unit, can not only detect intrusion attempts, but also provide a video coverage of the suspicious area, for remote vigilance. Moreover, it is equipped with mechanisms for automatically firing at the target. This paper also discusses its prototype, which has been successfully developed, not with all the above-said features though, due to practical difficulties. The paper is organized as follows: Section II discusses the system configuration and Section III describes Components or Subsystems Description. A Wireless Camera explained in Section IV and. A Result has been illustrated in Section V and Finally conclusion of this paper in Section VI.

II. SYSTEM CONFIGURATION

A block diagram of this system is depicted in Fig.1. This system uses surveillance camera for imaging, as they can be used regardless of the amount of ambient light, rendering its usage in the night as well. These cameras are lined up along the borders, at a certain distance apart from each other, depending on the range of the cameras. These cameras which continuously scan the corresponding areas of the border are in turn connected to a Digital Signal Processing (DSP) [2] unit, which accomplishes the task of intrusion detection by continuously comparing the images obtained, with a reference image and also with the images captured previously. Any sign of change in the successive images indicates dubious movements in that area, which would result from intrusion. This is immediately reported, by means of a wireless communication system comprising a satellite, to a centralized control room, which may be located far away from the borders, in a convenient location.

Fig.1. The Block Diagram.
The authority at the control room is then facilitated a Real-Time video-coverage of the area under consideration, in order to provide scope for human-judging. Upon ensuring that the cause of alarm is indeed an intruder, a ‘fire’ command is sent to the Automatic Firing Unit (AFU), which, based on the target locations determined by the DSP, automatically fires at the target. The AFU is built out of a gun-turret equipped with stepper/servo-motors to facilitate accurate three-dimensional motion. Since, the actual firing takes place only at the discretion of the concerned authority, and not by this device itself, possibilities of stake to innocent lives, due to false alarm, are ruled out. Thus, several kilometers of the borders, which would have otherwise required several hundred personnel, can be effortlessly monitored with this system, with only a few personnel.

III. COMPONENTS OR SUBSYSTEMS DESCRIPTION

A. LPC2148 Microcontroller

LPC2148 microcontroller board based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontrollers with embedded high-speed flash memory ranging from 32 KB to 512 KB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30% with minimal performance penalty. The meaning of LPC is Low Power Low Cost microcontroller. This is 32 bit microcontroller manufactured by Philips semiconductors (NXP). Due to their tiny size and low power consumption, LPC2148 is ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale.

![Fig.2. LPC2148 Microcontroller Architecture.](image-url)
Computer Controlled Intrusion-Detector and Automatic Firing-Unit for Border Security

Fig.2 shows the LPC2148 Microcontroller Architecture. The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue.

i. Features of LPC2148 Microcontroller:
1. 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
2. 8 KB to 40 KB of on-chip static RAM and 32 KB to 512 KB of on-chip flash memory; 128-bit wide interface/accelerator enables high-speed 60 MHz operation.
3. USB 2.0 Full-speed compliant device controller with 2 KB of endpoint RAM. In addition, the LPC2148 provides 8 KB of on-chip RAM accessible to USB by DMA.
4. One or two (LPC2141/42 Vs, LPC2144/46/48) 10-bit ADCs provide a total of 6/14 analog inputs, with conversion times as low as 2.44 ms per channel.
5. Single 10-bit DAC provides variable analog output (LPC2148 only).
6. Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.
7. Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.

B. Power supply circuit
The main building block of any electronic system is the power supply to provide required power for their operation and is as shown in the Fig.3. For the microcontroller, keyboard, LCD, RTC, GSM, +5V are required & for driving buzzer +12V is required. The power supply provides regulated output of +5V & non-regulated output of +12V. The threeterminalsIC7805 meets the requirement of +5V regulated. The secondary voltage from the main transformer is rectified by electronic rectifier & filtered by capacitor. This unregulated DC voltage is supplied to the input pin of regulator IC. The IC used are fixed regulator with internal short circuit current limiting& thermal shutdown capability.

C. DC Motors
For the movement of our robot, we are using DC motors. It is operated by 12VDC power supply. In any electric motor, operation is based on simple electromagnetism. A current carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field.

Fig.3. Power Supply Module.

D. Motor Driver L293D
In motor driver circuit, L2939 IC is used as a Motor Driver IC which allows driving a DC motor shown in fig.4. L293D is a 16-pin Integrated Circuit which controls a set of two DC motors. Motor driver’s acts as current amplifiers as it takes a low-current control signal and provide a higher-current signal, is used to drive the motors.

Fig.4. Motor driver circuit

The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads and switching power transistors. To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. This device is suitable for use in switching applications at frequencies up to 5 kHz. The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking. The chip is designed to control 2 DC motors. There are 2 Input and 2 output pins for each motor. The behavior of motor for various inputs is shown in Table 1.

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IV. A WIRELESS CAMERA

Wireless technology is being applied to just about everything these days, and video surveillance takes good advantage of it. A wireless camera is one with a built-in transmitter to send video over the air to a receiver instead of through a wire as shown in below figure. The thing that many people aren't aware of is that there are multiple types of wireless technology in use, each with unique advantages and disadvantages. Most wireless cameras are technically cordless devices, meaning that though they transmit a radio signal, they still need to be plugged in to a power source. Wireless is the commonly used industry term, though. Some do have batteries, making them truly wireless, but these tend to only last for a few hours at a time between charges. These devices work on a simple principle. The camera contains a wireless radio (RF) transmitter. This transmitter broadcasts the camera's video, which can be picked up by a receiver, which will be connected to a monitor or recording device. Some receivers have built-in storage, while others must be connected to a DVR.

B. Types of Wireless

Whether analog or digital, most commercially available electronic devices that broadcast do so in either the 2.4 GHz or 5.8 GHz ranges.

1. 2.4 GHz
   - Available in digital and analog
   - Has a maximum practical range of about 700 feet
   - A single receiver can carry a maximum of 4 transmissions.
   - The frequency most cordless/wireless devices transmit on, so analog devices are very prone to interference.

2. 5.8 GHz
   - Available in digital and analog
   - Maximum range of about 2000 feet
   - A single receiver can carry a maximum of 8 transmissions
   - Used by fewer household devices, less prone to interference
   - Analog signals can still be picked up by outside receivers

3. Wi-Fi

Wi-Fi cameras are wireless IP cameras. They allow multiple devices to be networked together and access a local area network through a wireless router. Each device talks to the router, which can send information back and forth to other networked devices as well as to and from the internet. A typical Wi-Fi router has a range of about 150-300 feet and can (for practical purposes) connect as many devices as they have bandwidth to support. Typically, routers are not included with these cameras and must be purchased separately. What makes Wi-Fi cameras so popular is that they allow remote access to a video feed from outside the

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### TABLE 1: Behavior of Motors

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<thead>
<tr>
<th>Operation</th>
<th>A</th>
<th>B</th>
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<tbody>
<tr>
<td>Stop</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Clockwise</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Anti Clockwise</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Stop</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
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Fig.5. Wireless camera
network. Set up can be more complicated than traditional wireless cameras and usually requires the user to have a PC available to set up the camera.

4. Cellular

Cellular cameras, sometimes also called 3G cameras contain a cellular transmitter and connect to a cellular network to send video. In function, they can be very similar to Wi-Fi cameras. This is the newest of the wireless technologies, and reliability can vary widely, largely based on network conditions. These also tend to be very costly. Not only is equipment expensive, but it also requires a cellular data plan in order to transmit video. These costs can vary by cellular carrier, and a lack of cellular coverage can render the devices inoperable. As costs drop, expect to see this type of camera become more and more popular.

C. Manual of RC100 - A Wireless Supervision Receiver

The RC100 is wireless supervision receiver. This product is suitable for the supervision of the places such as supermarkets, department stores, homes, workshops, hospitals and so on.

1. Basic specification parameters

- Receiving Frequency: 950 MHZ–1200MHZ
- Video output: 75Ω/1vp-p
- Audio output: 10kΩ/200mvp-p
- Power consumption :< 2w
- Work Temperature: 0~40°C
- Size: 115mm × 60mm × 20mm

2. Diagram of the whole products

3. Operating Instruction

1. Camera Temperature

- Install the camera transmitter on the place you need to monitor.
- Insert the DC +8V/200mA power adaptor into the interflow power plug, and insert its DC output plug into the DC input plug of the camera transmitter to put through the circuit.

V. RESULTS

The program was successfully tested on various instances of intrusions, and for various ambient conditions, in the laboratory. In this section, one of the cases is illustrated. An Intrusion was simulated by a person suddenly appearing in front of the camera, while the program was in action.
VI. CONCLUSION

A working model of the proposed system has been devised. The performance of the system is found to be satisfactory in the laboratory. Its response is found to be dependent on ambient light, and therefore, it requires calibration for a given environment. It is clear that, this system, if deployed in the borders, can simplify the task of safeguarding them and also reduce the overall personnel-count.

VII. REFERENCES


Author’s Profile:

Mr. Venkatapathi Pallam, presently working as an Assistant Professor at Malla Reddy College of Engg, Secunderabad. He completed M.Tech (Digital Systems and Computer Electronics) in 2009 from JNTU Hyderabad (A.P), India, B.Tech in ECE in the year 2004 from KSRMCE Kadapa (A.P). He has 9 years of experience in the field of teaching. He is a life member of ISTE. His area of research interest includes multimedia systems, communication & signal processing.

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