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## SECURITY SURVEILLANCE ROVER WITH SOLDIER HEALTH MONITORING USING IMAGE PROCESSING

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### ABSTRACT

In highly secured area the border security was totally depending up on soldiers. When the soldier was not able to detect the enemy they could easily enter the border area. The soldier plays a vital role in patrolling border area. So for increasing the security level and to monitor the health of the soldier. An ARM7 microcontroller based automatic gun targeting system and soldier health monitoring system which is mounted on soldier's body which uses zigbee technology is introduced. The main purpose of this automatic gun targeting system is to secure the border which will reduce the human effort. Here a technique called face recognition is used for detection of intruders. The proposed system contains tracking and health monitoring system based on zigbee which can be affixed to soldier's body to track the current location and the health status. This information will be transmitted to the rover through zigbee so that the rover moves towards the soldier in case of any emergency using the GPS location. This is a low-cost system for the protection of soldier's life.

### KEYWORDS

LCD, Temperature sensor, Heartbeat sensor, Thermo electric unit(Peltier), Push button switch, ATmega328, GPS Module, DC Motor, Buzzer, Ultrasonic sensor, LPC2148, Zigbee, Image Processing.

### 1. INTRODUCTION

Nowadays the supervision of international border has become a difficult task, sometimes it is not possible to observe the borders each and every moment. Army has to undergo a lot, due to unavailability of data the damage occurred to its personnel, which increases the disability toll. This can be reduced in real time if the data is available and can also maintain health status of the soldiers and protect the soldier's life. To perform all this operation here we introduce "Security surveillance rover with soldier health monitoring using image processing". This can be used to monitor the border and also the soldier health status with the help of rover unit and soldier unit.

The basic purpose of the rover is to continuously sense the object using ultrasonic sensor within a given range, if any object is detected that object will be captured using camera and processed with the help of image processing using MATLAB. And the image

captured will be compared with database, if the image is matched, rover will return to its normal position by sending a message as "Not an Enemy". If the image does not match with database, then command from MATLAB will be sent to rover as "Enemy Detected" and laser (gun) will target the object and if target was correct buzzer will turn ON and laser will be turned ON. This system can reduce the human effort.

Another purpose of the rover is to maintain health status and tracking the current location of the soldier. This soldier unit will be placed on soldier's jacket to continuously monitor soldier's heart beat rate per minute, if the value falls below or above the threshold level a message will be sent to rover for further process. And it also monitors temperature if it falls below the threshold level thermoelectric will turn ON. Placing of the thermo electric unit depends on where the soldier works. If he works in cold area, then the hotter part of

the thermo electric unit is placed towards him and cool part towards atmosphere vis versa. This will bring the temperature to normal condition. Then there will be a 4 push button keys which are predefined, if soldier pressed any of these keys the predefined message will be sent to rover for further process this communication is done using zigbee technology.

## 2. SYSTEM ANALYSIS

### A. Limitation of existing system

In the existing system it is not possible to observe the border area each and every moment to identify the intruders. The cameras that are mounted at fixed position which can cover only limited area which restricts the security.

There are no immediate precautionary measures to save the life of the soldier as the existing system is a manual health monitoring system. There are no jackets which can monitor health of soldiers.

### B. Proposed System Features

The proposed system is capable of automatically targeting the intruder with the help of sensor which shares maximum responsibility of soldier by mounting a camera on the rover unit which patrols in border area. It works both in network and non-network areas. The tracking and health monitoring of soldiers' is made possible and immediate precautionary measure is taken by the communication between the rover and the soldier.

## 3. SYSTEM DESIGN

### A. Power Supply Unit

The power supply unit consists of the step-down transformer mainly. This transformer is provided with supply of 230V, 50Hz ac signal from main supply. The suitable transformer is selected based on its output ranges from 10V to 12V. This output supply from transformer is mainly used to provide +5V.

The step down transformer is fed with input ac voltage of 230V, the ac voltage is step down using this transformer. Initially, a capacitor filter which is used to produce a dc

voltage. This voltage usually consists of the ripples. A regulator circuit is used to remove these ripples to get a regulated DC output. To produce voltage regulation a proper number of voltage regulation IC units should be used.

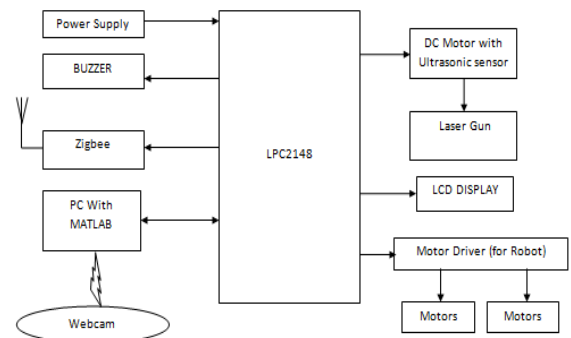


Fig.1 Block Diagram of Rover unit

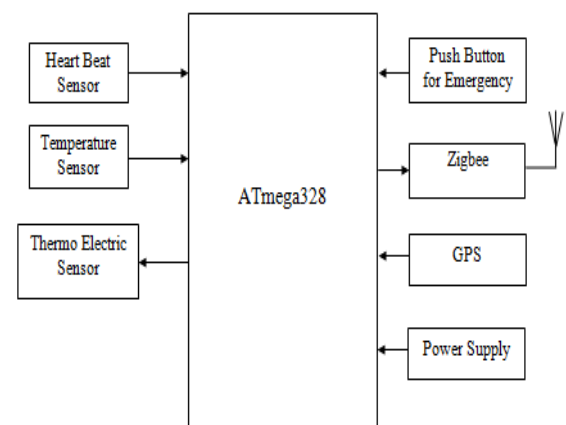


Fig. 2 Block Diagram of Soldier unit

## B. Microcontroller

### 1. Arduino(ATmega328)

It belongs to Low Power Atmel AVR 8-Bit Microcontroller Family. It consists of 32 x 8 general purpose working registers. The board has 14 digital pins and 6 analog pins. It has 1KBytes EEPROM, 2KBytes Internal SRAM, On-chip 2-cycle Multiplier and operating voltage of 1.8 - 5.5V.

The Arduino board acts as the heart of the soldier unit as it controls the components that are interfaced and used to communicate with the peripheral devices.

### 2. LPC 2148

Advanced RISC Machine and it is a single chip IC. The ARM7TDMI-S is a general purpose 32-bit microcontroller that offers

high performance and very low power consumption. It has 2 ports, 64 pins IC and 10bit ADC and DAC. Its operating voltage is +3.3v and the operating frequency is up to 60Mhz. It has 8 kB to 40 kB of on-chip static RAM, and 32 kB to 512 kB of on-chip flash memory.

The ARM7 acts as the heart of the rover unit as it controls the components that are interfaced and used to communicate with the peripheral devices.

### C. Heartbeat Sensor

Heart beat sensor is used to count heart beat rate per minute whenever the finger is placed on it. The fingertip is placed on the sensor which acts as a reflector to the incident light. The light which is reflected back from the fingertip is detected with the help of phototransistor. It works on light modulation principle. It starts counting when blood flows through finger at each pulse. Its operating voltage is +5v DC and operating current is 100mA.

### D. Temperature Sensor

The temperature sensor that is used is LM-35. Temperature sensor is usually used to measure the temperature in °C. Temperature can be measured more accurately compared to thermistor. Its operating range is from -55°C to 150°C. Its scaling factor is 0.01V/°C.

### E. Peltier-Module(SeriesTEC1-2706)

Peltier is also called as Thermo electric unit. It is a solid state device. Maximum operating temperature is 138°C. When current pass through the device it converts one form to other. Temperature can be increased from 25 degree to 50 degree.

Placing of the Peltier depends on where the soldier works. If he works in cold area, then the hotter part of the Peltier is placed towards him and cool part towards atmosphere vice versa.

### F. Push Button Switch

A 1x4 push button switch is connected in parallel and it consists of 4 Pull-up resistors, if the switch is closed a direct connection is given to ground. If the switch is open the rest

of the circuit would be left floating. This push button is used to send predefined messages to the rover unit.

### G. GPS

This GPS KIT is a communication module connected to PC. The GPS user segment consists of the GPS receiver. The main operation of the GPS receiver is to collect and process the signal from the GPS satellites that are in view. After which the information can be extracted like longitude, latitude, time which is helpful to find location and timing information.

### H. ZIGBEE

Zigbee is a wireless technology operates on the IEEE 802.15.4, the frequency ranges 2.4GHz, 900MHz and 868MHz. It has range 100m, Memory 32-60 KB. It is developed as an open global standard to address the unique needs of low cost, low power wireless IOT networks.

### I. Ultrasonic sensor

An ultrasonic sensor is a transducer which is divided into two categories transmitter and receiver, transmitter does the operation of converting the electrical signals into ultrasounds, and receiver does the operation of converting ultrasounds into electrical signals. These sensors work on the principle of piezoelectric transducers. Its range is from 2cm to 400cm. This sensor is used to detect the obstacles

### J. Buzzer

A buzzer or beeper is an audio signalling device which may be mechanical, or piezoelectric, electromechanical. It is used in automobiles, alarm devices, timers, household appliances, whenever a confirmation message from the user is sent and used to indicate that a button has been pressed or a ring or a beep.

### K. DC Motor

A DC motor works on the fact that unlike magnetic poles attracts and like magnetic poles repels each other. An electromagnetic field is generated around the coil which



carries the current. The direction of generated magnetic field can be switched 180° by switching the direction of current in the coil. The magnetic field can be switched on or off by switching the current in the coil on or off.

## L. H-Bridge

“H-bridge” is a transistor configuration that controls the DC motors. It has 4 mechanical or solid-state switches, 2 NPN and 2 PNP transistors. One PNP and one NPN transistor are activated at a time. The voltage that is flowing through the circuit changes its direction so as to control the motor rotation in clockwise or anticlockwise direction.

## M. Relay

It is an electromagnetic switch used to turn ON and OFF a circuit by a low power signal. Relays are mainly used for two basic operations one for high voltage and low voltage applications. Its operating voltage is +5V.

## N. LCD (16024)

It is a 16X2 LCD (Liquid Crystal Display). It can display 2 lines of 16 characters per line. Each character is displayed in pixel matrix form of 5x7. It consists of two registers command and data. It is used to display the messages from the rover and the soldier unit.

## 4. FLOW DAIGRAM

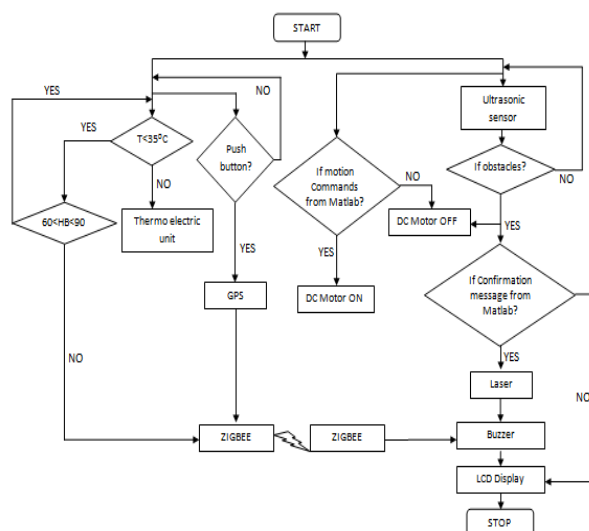


Fig. 3 Flow chart

The system is turned ON initially. The flow chart comprises of both soldier unit (left) and the rover unit (right) which communicate with each other with the help of zigbee. In the soldier unit (left) initially starts with sensing the temperature of the soldier using temperature sensor and if the temperature goes beyond the threshold level (>35°C), then automatically the thermo electric unit which turns ON and brings down the temperature to normal condition and if the temperature was normal the heart beat sensor starts counting the beats per minute (BPM), if the output lies between the permissible level then it is said to be normal and again the process of counting the BPM and sensing the body temperature goes on, and if not then the message will be sent through zigbee to the rover unit, which turns ON the buzzer and display the appropriate message on LCD.

Whenever any key on the push button is pressed a message along with the GPS location is sent through zigbee to the rover unit where the rover unit will be able to move towards the soldier based on the location that is shared. On the other hand rover unit (right) starts sensing the object with the help of ultrasonic sensor and if the obstacle is detected then DC motor will automatically turn OFF. Then it waits for the confirmation message from Matlab, after receiving the confirmation message the laser, buzzer will turn ON and the appropriate message will be displayed on LCD and if a non confirmation message is sent then again a different message will be displayed on LCD. A continuous sensing of the motion commands from Matlab will be checked for, if the commands arrive at the rover unit the DC motor for motion will be turned ON else it will be turned OFF.

## 5. HARDWARE AND SOFTWARE IMPLEMENTATION



**Fig. 4 Experimental setup of rover unit and soldier unit**

The software used for the rover unit and the soldier unit is Keil  $\mu$ vision 4 the code is written in embedded C language and Arduino IDE the code is written in C/C++ respectively. The software used for image processing is MATLAB.

The face recognition method that is used in this proposed system is EHD (Edge histogram descriptor). Image is initially divided into 4x4 non overlapping blocks which is called as sub-image. Each sub-image is described with the help of EHD which basically represents the sub-image with the help of 5 types of edges they are horizontal,

vertical, 45-degree diagonal, 135-degree diagonal and non-directional edges. The Image partition gives rise to 16 equal sized sub-images. These sub-images are categorized with the help of the histogram of edge distribution for each sub-image. This histogram represents the relative frequency of occurrence of corresponding sub-image's 5 types of edges.

The edge extraction from the particular image is done based on the image-blocks as a basic unit. To extract the directional edge feature a small square image blocks in each sub-image should be defined.

In a spatial domain to extract an edge feature in the image-block is to apply digital filters. It is done by dividing the image block into 4 sub blocks then the labels are assigned for each sub block ranging from 0 to 3 and with help of filter co-efficient for vertical, 45-degree diagonal, 135-degree diagonal, horizontal and non-directional edges with the help of appropriate formula we get to know the corresponding edge in each image block with which edge features of each image is extracted and compared with the help of EHD.

## 6. RESULT



**Fig. 5 Messages from Soldier Unit**





**Fig. 6 Messages from MATLAB**

The messages from the soldier unit is sent to rover unit in case of any variations in the heart beat of the soldier and if the soldier presses any button in the push button a predefined message along with the location of soldier is sent to rover unit so that the rover moves towards the soldier and along with that if any intruder is found in the secured area an appropriate message depending upon the confirmation message from MATLAB is displayed on the LCD.

## 7. CONCLUSION AND FUTURE SCOPE

### 1. Conclusion

The main purpose of this paper is secure the border areas with the help of rover unit and to monitor and track the health status of the soldier using soldier unit.

The proposed system is used to reduce the human efforts, increase the security level and provide life security to the soldiers who patrol the border area. In this model the automatic gun targeting system is mainly based on the ultrasonic sensor which senses the obstacles and after which the face recognition is done with the help of MATLAB software which sends the confirmation message. On receiving this message the buzzer, laser will be turned ON accordingly the message will be displayed on LCD. The soldier health monitoring system which consists of the biomedical sensors which would be intact with the soldiers' body and a push button which is provided for soldier in case of emergency, if any button is pressed a predefined message with GPS location would be sent to rover unit so that it moves towards the soldier.

### 2. Future Scope

Rather than using zigbee we can use Wi-Fi module for better communication between the soldier unit and the rover unit as they both operate in the same environment.

Instead of using ultrasonic sensor which detects all objects around it. We can use PIR sensor in real time as the battery life can be saved as it detects only the living objects.

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