

Android Based Autonomous Intelligent Robot for Border Security

C.M.Naveen Kumar¹, Dr.B.Ramesh², Prof. G. Shivakumar³, J.R.Manjunath⁴

^{1,2,3}Malnad College of Engineering, Hassan-573202, Karnataka, India
⁴Quad Technologies, Bangalore560073, Karnataka, India

Abstract: *Trespassers cross our borders unknowingly. It is not possible for our soldiers to watch the borders at each and every moment. The key use of autonomous intelligent robotic systems is to provide remote surveillance using a security robot. An essential requirement in security is the capability to automatically detect trespasser in borders, to inform nearby control unit and to empower security personnel to track the trespasser. In this paper we propose an autonomous intelligent robot which identifies trespasser using PIR motion sensor, alerts security personnel by sms using GSM and captures image of trespasser using camera in Android device and mail this image to specified e-mail id using Android based application. This development enables security personnel to effectively detect the and at low cost to identify a potential intruder.*

Key Words — PIR motion sensor, GSM, Android, Autonomous Robot

I. INTRODUCTION

Now a day's robotics research focused mainly on design and development of autonomous and compliant movable robots for unstructured and natural environments such as planet surfaces rather than for structured industrial environments. These robots can be used to accomplish tasks like rescue, security, surveillance in unstructured and natural environments. This class of robots can be utilized for tasks in the hazardous environments where human is not capable of doing it. [1] emphasizes on the skill of mobility which deals with the motion of mobile robot in an unstructured, unsupervised and real-world environments in order to reach its goals. Here the focus is on locomotion and choice of particular locomotion mechanism which is best when compared to its substitutes [6][7].

An Internet-based intelligent robot security system, "iBotGuard" in [2] detects trespassers using face recognition algorithm. System can detect a trespasser using intruder detection subsystem which relies on

invariant face recognition and it tracks the trespasser using intruder tracking subsystem based on streaming technology. Intruder detection subsystem captures images periodically when it detects trespasser in a secure area and verifies whether the object detected is human using invariant face recognition algorithm then robot will alert the security guards through alert signal using internet. The security guards use the images in robot camera to control robot motion and to recognize trespasser.

The reconnaissance robot [3] can be operated in three different ways in accordance with user requests and possessions of task:

(a). *Patrolling mode:* Here reconnaissance robot roams in the environment and tracks predefined routes unconventionally. It will send key information related to security to the server for further analysis.

(b). *First Responder mode:* The reconnaissance robot will work in collaboration with fixed monitoring devices and it is programmed. It will be directed to target location in order to perform on-site inspection when a security related event is reported by one of the monitoring device. Obstacles in its path can be avoided by creating a deviation or unswervingly jumping over them.

(c). *Remote Control mode:* In this mode remote user will navigate the surveillance robot to the target region. Security system can be accessed by the users through PCs, mobile phones and PDAs.

Android is an open source solution introduced by Google. Mobile phone manufacturer can use it as a software development platform. The Android operating system is built on a modified Linux kernel. Java applications running on a virtual machine is in software stack and system components are written in Java, C, C++, and XML. Android phones have many built-in activities including email, a Web browser, and a map application. Users can customize the phone since Android holds a replace-and-reuse philosophy. Today's smart phones provide better processing power as PCs with numerous rich applications [5]. Our communication and information desires can be effectively fulfilled by Smart phones. A smart phone's ability to match our lives is directly related to the richness and quality of its mobile applications. One Android application cannot access other applications without explicit user permission and runs in its own space. iPhone applications can access many system

resources by default, thereby let iPhone applications access user information without user permission and it can access system resources by default. In case of Android, Users have a control of services accessed by Android application so they regulate their security and privacy [4].

II. PROPOSED METHOD

The design and development of the proposed system is discussed here.

(a). Android Application:

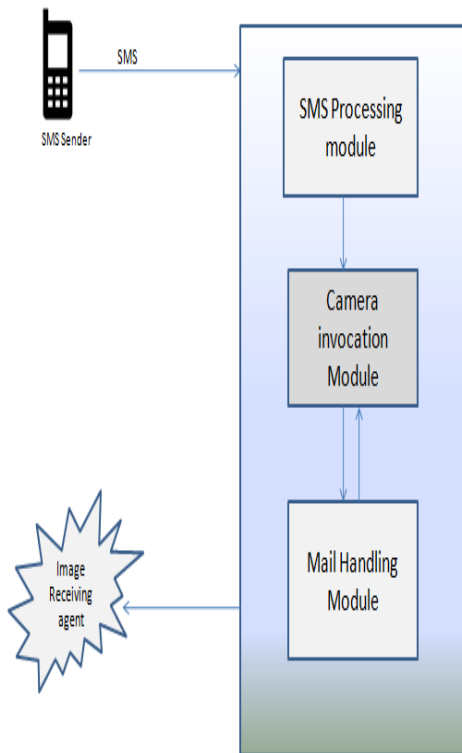


Figure 1. Modules in Android Application.

Application mainly includes three modules:

1. A broadcast sms receiver is an Android component which allows listen for sms message received. Based on message characteristics like particular command as text or sender id it will invoke camera application.
2. Camera application takes image of current position and through Android operating system other utilities

saves into memory and invoke mailing module.
3. Mailing module will take up last updated image and attaches it to mail and send it to preconfigured mail id with preconfigured text content.

(b). Flow Chart:

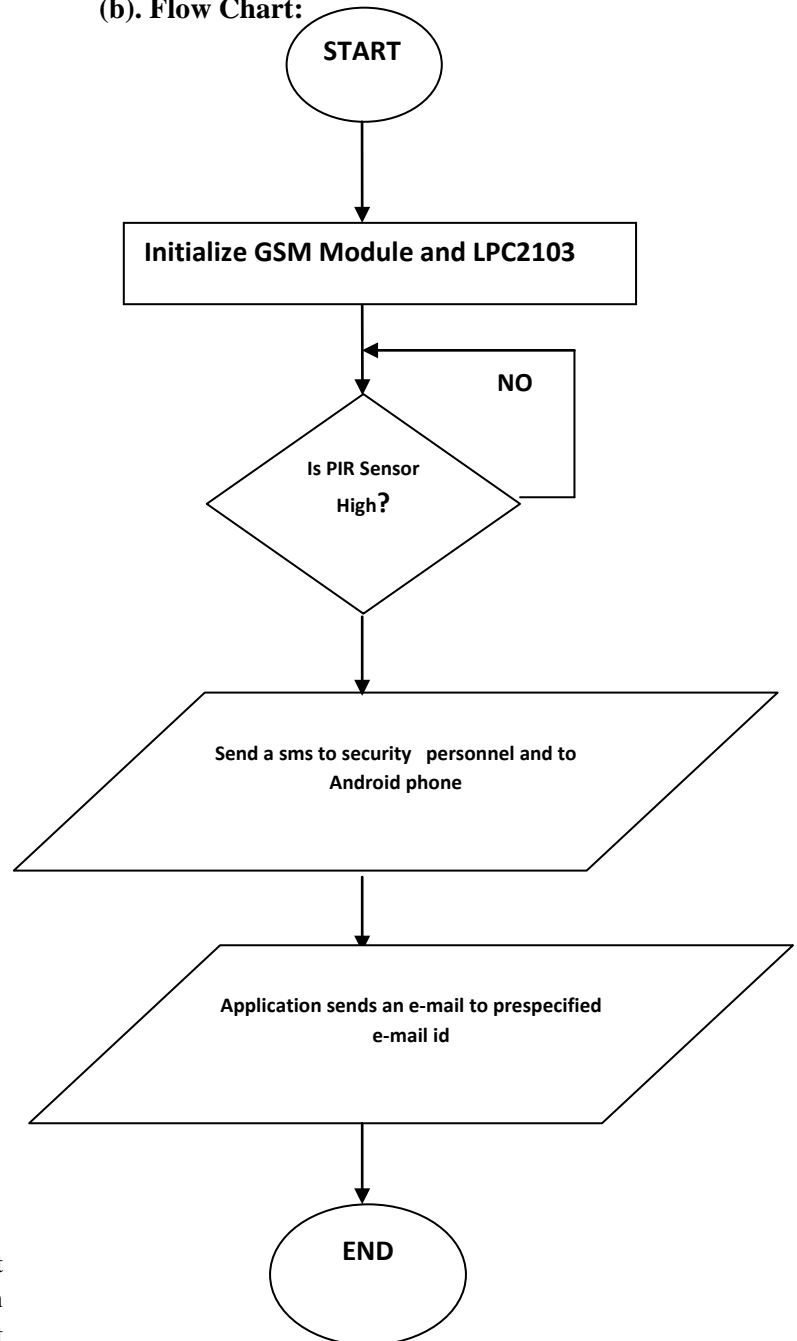


Figure 2. Flow Chart showing sequence of operations.

(c). Experimental Procedure:

First we initialize GSM module and LPC2193 to configure special function registers. This autonomous robot will be left in borders; robot will move randomly and have Passive Infrared Sensor (PIR) sensor connected to the I/O pins of LPC2103. A PIR sensor [8] is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. It is used to sense movement of people, animals. Here sensor will keep on checking for the human motion, in case any human motion is detected then robot will send SMS to military authority and to the android device mounted on robot. When android device receives the message the android application will be activated and it directs the device to capture the image then it will upload that image to specified email id.

LPC2103, an ARM processor from NXP is used to implement this scheme. LPC2103 is the core of the project, which controls the whole system. It contains 1K RAM, 64K Flash, 3 Timers, 32 external interrupts sources, 2 UART, 32 GPIO's, ISP programming support . KEIL IDE is used to program the microcontroller and the coding is done using Embedded C.

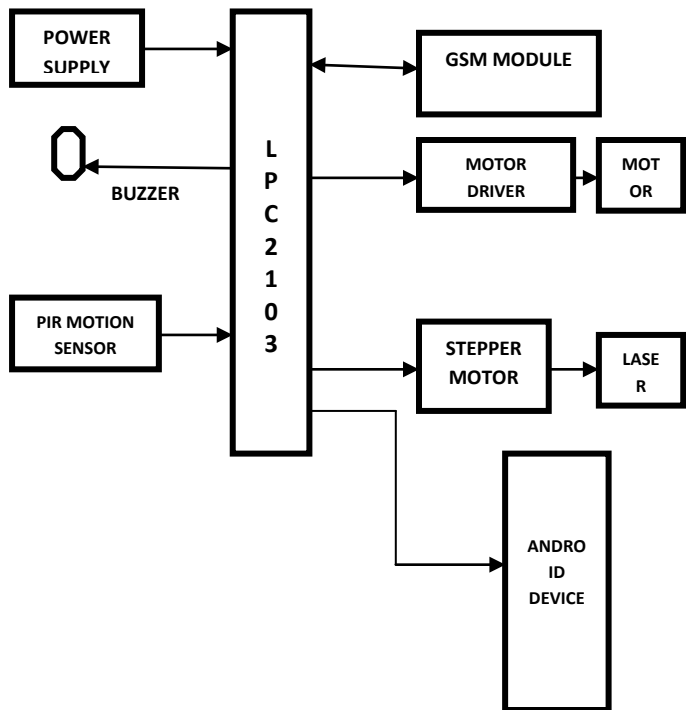


Figure 3. Block Diagram of proposed system.

Using this scheme you can see detected human photo from anywhere in the world using email and you can identify enemy.



Figure 4(a)



Figure 4(b)

Figure 4(a) and (b) shows the images of the proposed robo

III. RESULTS

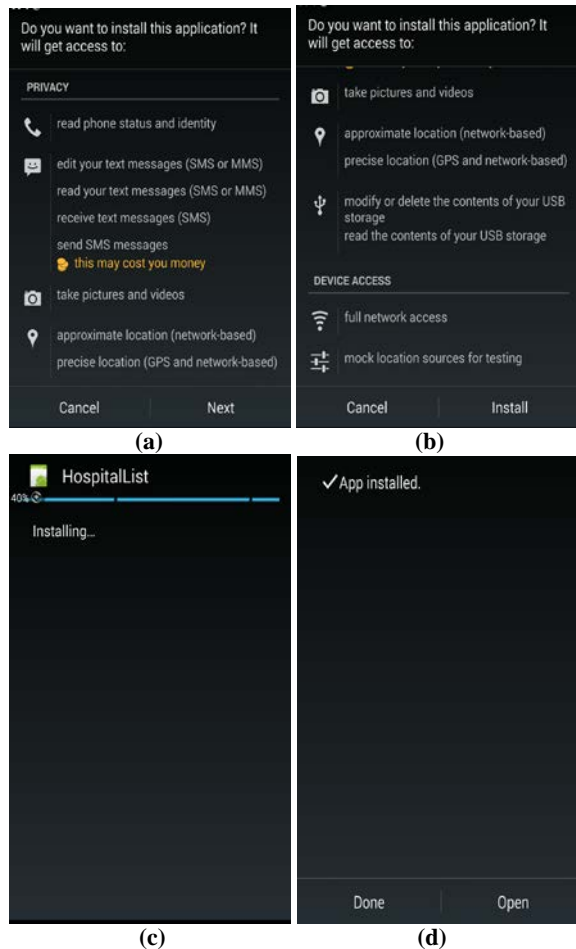


Figure 5 (a), (b), (c), (d) shows different stages in installation of the android application



Figure 6. Image captured by android phone when human is detected.

The output of PIR motion sensor in volts for different distances in meters between sensor and human is tabulated in Table. 1

Meters(m)	Output Voltage (V)
0.5	4.84
1	4.86
1.5	4.85
2	4.86
2.5	4.87
3	4.86
3.5	4.85
4	4.85
4.5	4.86
5	1.2

Table 1. shows the output of PIR motion sensor in volts.

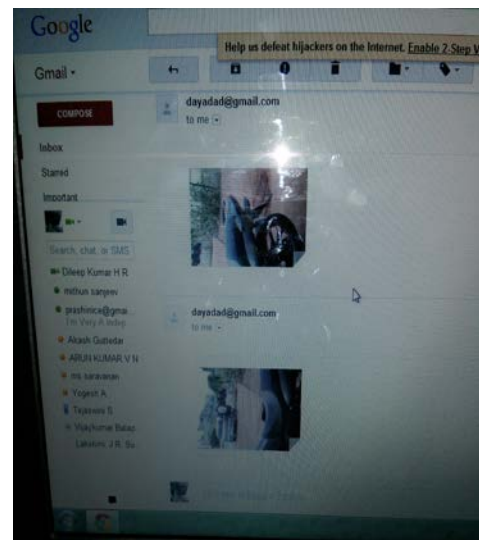


Figure 6. Snapshot showing image which is mailed by the android phone to prespecified email id.

IV. CONCLUSIONS

A Security interface is obtained to Android mobile device. This is a short range system and can be extended to long range by choosing proper PIR motion sensor and it is simple in its operation. The range and security features were achieved through the use of the internet in the mobile device. The system was able to send sms to specified number of the security personnel and to the android mobile which is

on the robot when PIR motion sensor detects intruder. PIR motion sensor is connected to one of the pin on the input port of LPC2103 and depending on sensor signal status; when it is high, LPC2103 sends the control signal to GSM module in order to send sms .After the reception of the sms application in the android mobile gets activated which in turns takes the image of the intruder and upload that image prespecified email id. Design and development of better battery backup system can be included for the future work. Improvements like video streaming could also be another aspect for future work. This work could also be extended to Nuclear Power Plant to restrict trespassers from reaching restricted area.

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About Authors



Mr.C.M.Naveen Kumar obtained BE degree from MCE, Hassan during 2010. He is serving MCE since 2010 as Assistant Professor. He is currently pursuing M.Tech (PT-QIP) in **Computer Science and Engineering** in MCE, Hassan. He has attended **9** workshops/ Symposiums. . His areas of interest are Signal Processing, Digital Image Processing.



Dr.B. Ramesh did his **BE** from Mysore University in 1991 and **M.Tech** from DAVV, Indore and **Ph.D** from Anna University, Chennai in 2009. His area of interests are Multimedia Computing, Mobile ADHOC networks. He has published 6 national and 13 international journals. He has 23 years of teaching experience. He is currently working as Professor and HOD in department of CS&E in MCE, Hassan.



Prof. Mr. G. Shivakumar obtained BE Degree in**1990** from MCE, Hassan, **M.Tech** in **1998** from **IIT Kharagpur** and **PGD(HRM)** from **KSOU Mysore** in **2005**. He is currently registered for PhD (external) in VTU. He is serving MCE since **1990** and presently working as Associate Professor.. He has attended **32** workshops/ Symposiums. . His areas of interest are Microprocessor and Microcontroller based System Design, Soft Computing, Pattern Recognition, Affective Computing and Virtual Instrumentation. He has published **8** international journal papers, **14** international conference papers and 10 national conference papers to his credits.



Mr.J.R.Manjunath did his BE in Instrumentation Technology in MCE, Hassan in 2010. He is currently working as Executive Engineer in iQUAD Technologies,Bangalore-7