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Embedded Based 3G Security System for Prison

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Abstract

Safety measures and uninterrupted surveillance are essential in areas like bank safety locker room, defense systems, VIP's homes and Luxury hotels. Prison is also the place where there is a need for high security and severe surveillance system. There are several techniques used in these particular environments which include the traditional VHS (Video Home System) and DVR (Digital Video Recorder) system.VHS surveillance system usually has the video quality problem of displaying because the analog signal is directly sent to monitor without processing, which results in poor monitoring system. Instead the DVR demonstrates a better competence in the prison. The main objective of this work is to introduce the application of CCMS (Central Control and Monitoring System) with 3G technologies for prison management by using the low cost and low power sensors through the web or wireless network which reduces the manual work involved. It also reduces the money invested and power usage in providing electrical fencing in the prison. The use of motion detection sensors and additional digital I/O devices helps to prevent escapes of prisoners.

Keywords: PIC Controller, CCMS, Prison Security, DVR System, Vibration Sensor, Ultrasonic Sensor, Smoke Sensor.

1. Introduction

The general safety measures provided in prisons are electric fencing, high walls and other hidden earth works to prevent escape. But all these techniques are costly and needs much man-works. With a rapidly changing computer and information technologies, the CCMS based security system can be an alternative to these techniques [4, 6]. Upgrading the protection techniques like controlling the door access remotely, use of CCTV's for monitoring, automatic alarm systems are included in this system. It helps in establishing chronological sequence and duration of any incident within the building and is able to provide immediate reports on the potential threats. This CCMS can be further upgraded with more advanced application software to carry out analytical functions like motion detection using the vibration sensors, fire detection using smoke sensors, door open/close using ultrasonic sensors, taking snapshots of the scene using the automatic moving camera for intrusion detection. It can also help in routine reporting on suspicious persons and objects.

PIC (Peripheral Interface Controller) controller is an 8 bit Microcontroller most suitable for low end applications. PIC16F877A series controller used here is efficient and cost effective for this prison security system. The MikroC PRO for PIC controller provides a feasible solution for developing applications. The control switches and the e-map of the prison is designed in Microsoft Visual Basic 6.0. The prison security system uses different kinds of sensors like motion detection and fire detectors. These sensors are interfaced to the processor which monitors the different sensed values and acts accordingly.

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2. Existing System

A remote surveillance monitoring system was designed to protect the company's personnel from hazards in remote places and the result has been viewed in Lab VIEW [2]. A vision sensor to identify emergency vehicles over a road side with the Camera Closed Circuit Television (CCTV) was implemented recently. The CCTV captured the vehicle image by which the traffic light was controlled [9]. The ethical and legal significance of using smart CCTV is also discussed [5].

A novel model based on electronic monitoring was developed to improve the prison security. This was also useful in monitoring people under house arrest [7]. The CCTV cameras are being employed in prisons efficiently to prevent mishaps such as self-harm/suicide. Its usage in detecting escapes, collecting evidence and to make better safety in prison is analyzed. The CCTV systems were integrated with speakers, call buttons and video capture options [11, 3]. The behavior and association of correctional officers and the inmates was assessed based on performance dimensions [13]. Microcontroller based security door system for entering into rooms and buildings by using smart card were designed [10]. A fuzzy interface based adaptive network for secure door access model using voice command was also exist [12]. A keyless door access technique based on artificial neural network and face recognition method was also developed [1].

3. Proposed System

The work includes an enhanced prison security system based on the CCMS technique. In this system, the prison officers can monitor the environment in the buildings, especially the aisles or cells from the central room in the prison. To implement the high level security in the prison, software is integrated with the central controller for better surveillance. With this software, the jailer can monitor the prisoner's activities inside the prison. The software has a bookmark which can highlight when there is any risk conditions in jail. The regular activities of all prisoners are recorded in video form. A screen output shows the main screen of DVR/Cameras and other displays the e-Map of the prison. Once an event is triggered, the camera icon on the e-Map will turn out to red with sparkling. The prison officer can double-click the icon and watch the real-time video and inform related officers to secure and support the emergency. A motion detection sensor is placed in every corridor of the prison. If the prisoner tried to escape from the jail, sensor will detect it and gives an alarm signal. The frame of the camera screen will become red and the surveillance system will record the event. This system can be implemented using web or wireless network, through which even the higher official's can watch the activities of the prison from anywhere outside the prison.

The main system consists of the following sub-units: Central monitoring computer /workstation, PIC microcontroller, Outstation, Communication network, Vibration Sensors, Ultrasonic sensors, Smoke detector, Stepper motor, Alarm, Pointing device, Standby workstation. Graphical interface provided at workstation helps the operator to monitor the process through CCMS control. The user can enter the instructions and scheduling points into the workstation. The instructions entered by the user are then transmitted to the outstation which performs the control actions accordingly and also the workstation can collect the instructions from the sensors located in the outstation.

The block diagram shown below in Figure 1 is the workstation unit involving CCMS and user interface. The user at the workstation can monitor and control the actions at the prison.

The Figure 2 shows the outstation unit which involves the central PIC Controller and sensors placed in different areas of the prison. The main controller processes the sensed values and communicates to the workstation.

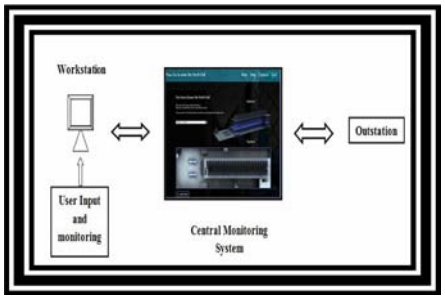

Figure1. Block diagram of workstation unit.

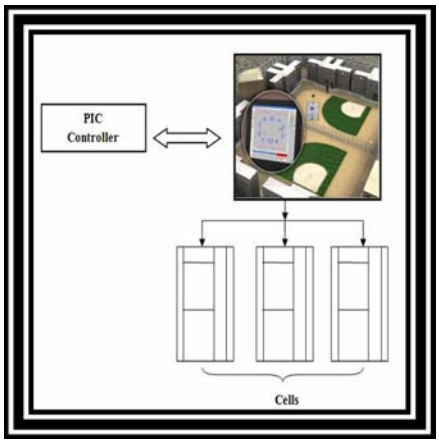

Figure 2. Block diagram of outstation unit.

4. Results

4.1 MikroC Pro Compiler

The mikroC PRO compiler for PIC is a product from Microchip for developing codes in PIC controllers. It includes additional features with advanced optimizations and many hardware and software libraries. The fully equipped functional software tools help to boost the efficiency of the developed project. These tools include LCD Character Tool, Seven Segment Editor, UART Terminal, HID Terminal, ASCII Chart, Active Comments Editor and Advanced Statistics [8]. The screenshots of the compilation window in mikroC pro is shown in Figure 3.

4.2 Microsoft Visual Basic 6.0

Visual Basic is an advanced version of BASIC programming language with visual and event driven programming. It is helpful in creating a graphical user interface in many applications with help of the components available on the window. Visual Basic 6.0 is the latest version used in this work. Figure 4 shows the screenshot for the security system in visual basic.

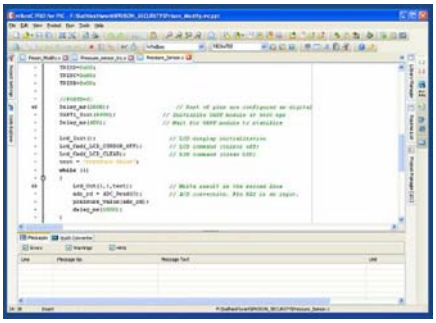

Figure 3. Screenshot of the compilation result in mikroC PRO.

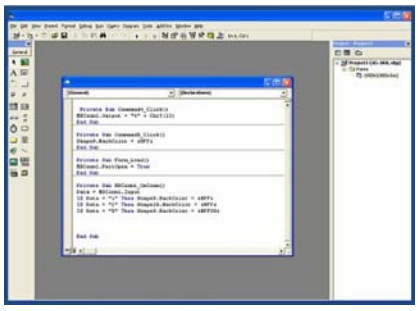

Figure 4. Screenshot for creating the main screen of the security system.

Figure 5. Login window.

The Figure 5 shows a login window, where the username and password is entered by the prison official.

Sample code for creating Login window using Microsoft Visual Basic is given below.

```
    (Creating username and password)

Private Sub Command1_Click()
      If Text1.Text = "JAILER" Then
      If Text2.Text = "AGENT41" Then
      MAIN.Show
      Enter.Hide
      Else
      MsgBox ("WRONG PASSWORD")
      End If
      Else
      MsgBox ("YOU ARE NOT PERMITTED")
      End If
      End Sub
Private Sub Command2_Click()
      End
      End Sub
```

After logging in, the user can view the E–map of the prison as shown in Figure 6.

The hardware implementation of the entire prison security model is given below in the Figure 7. The door access control, sensor status and video output screen are shown in the Figure 8.

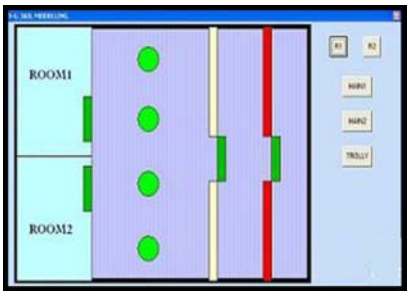

Figure 6. E-Map of the prison.

Figure 7. Hardware output of the entire system.

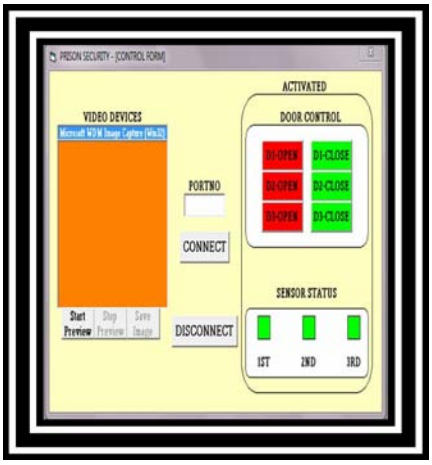

Figure 8. Output of software implementation.

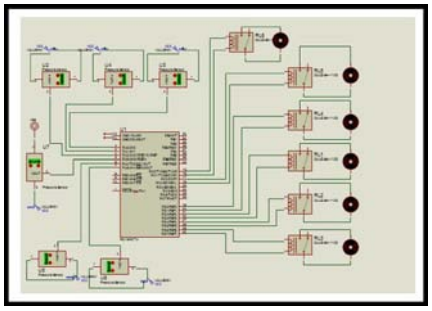

Figure 9. Emulator screenshot shows the connections with the sensors and motors.

Figure 9 shows the emulation screenshots using ISIS software.

5. Conclusion and Future Work

The proposed prison security system is fully automated and with this the manpower required can be reduced. The process can also be extended with automating the process of lighting system. This kind of security system can also be used in defense areas and in military applications. It helps the personnel to monitor the prison from remote places.

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