

# **PRISON CELL LOCK DETECTION AND NOTIFICATON**

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**This report is submitted in partial fulfillment of the requirements for the award of Bachelor Degree of Electronic Engineering (Computer Engineering) with Honours**

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**DECLARATIONS**

**“I hereby declare that this report is the result of my own work except for quotes as cited in the references.”**

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**“ I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Electronic Engineering (Computer Engineering) with Honours.”**

**Signature** : .....

**Supervisor’s Name** : .....

**Date** : .....

**DEDICATION**

**Special thanks to my family, project supervisor and friends**

## ACKNOWLEDGEMENT

I want to express my deepest appreciation to the God for His grace that supported my execution level at the pivotal times of finishing this Final Year Project entitled Prison Cell Lock Detection and Notification.

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## ABSTRACT

Increased concern for crime has led to an escalation in the number of prisons and prisoners. A prison is defined as a facility with offenders who is spending a period of time, generally more than two years. Despite the prison system is well outfitted with security, prison escapes still happen. Most prison escapes occurs through the prison cell door. Prisoners manipulate the cell door lock in order to prevent it from locking. Therefore, an idea of developing a prototype that will optimize prison security was proposed to solve prison escapes. This project concentrates on developing a detection and notification mechanism using Arduino Uno and Xbee Pro. Personal Computer with Visual Studio 2013 software will be able to validate whether the cell door in open or close position. This will alert the prison supervisor about authentication of the prison cell door. Prison Cell Lock Detection And Notification system is aspiring to be an small size affordable device which is composed by electronic based suitable for prison system.

## ABSTRAK

Peningkatan kebimbangan untuk jenayah telah membawa kepada peningkatan dalam bilangan penjara dan banduan. Penjara ditakrifkan sebagai kemudahan untuk pesalah yang menghabiskan tempoh masa, biasanya lebih daripada dua tahun. Walaupun sistem penjara itu dilengkapi dengan pelbagai keselamatan, banduan melarikan diri dari penjara masih berlaku. Kes melarikan diri dari penjara paling berlaku melalui pintu sel penjara. Banduan memanipulasi kunci pintu sel untuk mengelakkan ia dari mengunci. Oleh itu, idea untuk membangunkan prototaip yang akan mengoptimumkan keselamatan penjara telah dicadangkan untuk menyelesaikan masalah banduan melarikan diri dari penjara. Projek ini menumpukan untuk membangunkan mekanisme pengesanan dan pemberitahuan menggunakan Arduino Uno dan Xbee Pro. Komputer peribadi dengan perisian Visual Basic 2013 akan dapat mengesahkan sama ada pintu sel dalam kedudukan terbuka atau tertutup. Ini akan memberi amaran penyelia penjara tentang pengesanan pintu sel penjara. Pengesanan Pintu Dan Sistem Pemberitahuan Sel Penjara adalah peranti yang bersaiz kecil dan berpatutan yang berasaskan elektronik dan sesuai untuk sistem penjara.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

The prison system was already developed back in ancient time by Roman and Greek civilization. Offenders were placed in metal cages, quarries and the public building basement until their time limit exceeds. However, the earliest prison record stated in the period of the Middle Kingdom of Egypt (Spierenburg 1998)[16]. This is continued in the Middle Ages up to the seventeenth century. During this period, public building basement, fortresses and castles were often used as prisons. Evolution of prisons continues and modern prisons were developed. The nineteenth century saw the conception of the state prison. The first England state prison was Millbank Prison. Established in 1816, it held 860 prisoners, kept in divided cells. In spite of that, relationship with different prisoners was permitted during the daytime. Amid the end of the twentieth century, modern prison system and framework were finalized.

According to a research entitled World Prison Population List (tenth edition) conducted by the International Centre for Prison Studies (Walmsley 2012) over 10.2 million people including men, women and children were held in penal institution worldwide. Among them, 39 144 people are Malaysian prisoners. Malaysia has a prison population rate of 132 (per 100,000 of the national population)[17]. Today's prison system is totally different. Prisoners overcrowding is currently a significant issue in many prisons. Prison cells were initially built to accommodate one prisoner. Most local prisons do not use direct supervision management. For several decades, the

trend in prison management and architecture has been to reduce contact between staff and prisoners as much as possible.

Technologies are slowly adapting in prison systems to provide more security in order to reduce the number of prison escapes and to monitor prisoners' behavior. As years go on, mechanically operating prison cell door is refined and developed to electrically, electromagnetically and motorized operating prison cell door. Apart from that, many closed-circuit television (CCTV) was installed for surveillance purpose. Prison cells now can be monitored remotely. Other than that, technologies using radio waves[9], such as scanning devices can help to detect everything from mobile phone to a blade. (Bulman 2009) Moving one step ahead, Radio-frequency identification (RFID) technologies are the new technology used in prison nowadays. RFID tags are attached to the prisoner's body in a form of a wristband and thereupon tracking in and out movement of prisoners and to alert the guard about any abnormal centralization of individuals in a certain area. Prison security system has changed significantly in the most recent century and will keep continue on the grounds that technologies proceeds to progress.

By using one of the current technologies, detection and notifications can be done using Wireless Sensor Network (WSN). The wireless networking consists of few sensors to monitor any event or condition in which its data will be sent through wireless to another location or control centre. Although prison is well equipped with a tight security system, yet prison escapes still happen. The prisoners immediately figured out how to overcome these systems, making the prison security system basically futile. Prison escape is an act whereby a prisoner unofficially leaving away from prison. The attempt of illegally leaving the prison cell during unpermitted time is done by escaping through the prison cell door, window or breaking a cell wall. Prisoners escape without the knowledge of prison guard. Various security measures were being taken in order to prevent prison escapes and improve prison security system. Hence, there must be an efficient and reliable system to help the prison supervisor to keep an eye on their cells. Hence, this project is centered around the advancement of a Prison Cell Door Detection and Notification.

## 1.2 Problem Statement

Technologies have propelled such a great amount in the most recent decade. With the progression and leaps forward in technology throughout the years, Malaysian government keeps the emphasis on prison security system. Although prison cell is equipped with high security, prisoners were still able to escape from a prison cell. By manipulating cell door lock, prisoners are smart to escape from a prison cell. One of the methods used in cell door lock manipulation is by preventing the cell door from being closed after being in an open position for a certain period of time. Foreign objects such as paper, cellotape and cards are placed in any possible way around the cell door lock to avoid the cell door from being locked. Most prison cell escapes occur through the cell door. Traditional locking method with no lock detection has led to an escalation in the number of prison escapes. The safety of a prison cell is quite crucial to prevent dangerous criminals from escaping from prison as they could endanger public safety.

On top of everything, the guard on duty is unaware that prisoners are escaping. Even though prison is systematized with innumerable number of CCTV installed. Prisoners are wise to disguise to stay away from the CCTV camera recognition. Hence, there must be an efficient and reliable system to help the prison supervisor to keep an eye on their cells. Whenever the cell door is in the open position, data must be transmitted to the control system. Previously, wired network was used to transmit data, but it has several disadvantages. They are such, it is more time consuming and more expensive to assemble, take up more room and chaotic with cables, cables are potential to be harmed by cleaning teams and misplaced wires can result in tripping risks. This can be upgraded by using a wireless network in which multiple point can be accessed at one time. Thus, this project focuses on wirelessly detecting and notifying system called The Prison Lock Detection and Notification system, when activated, it shrewdly sends a notification message to the prison authority for further action.

### 1.3 Objective

The objectives of this project are as follows

- i) To develop a low cost electronic based prison lock detection mechanism
- ii) To design a graphical user interface (GUI) for notifying prison supervisor about the prison cell door lock condition

### 1.4 Scope of Project

By considering the time and budget constraint, there are numerous scopes that need to be defined. The proposed project's scope is outlined as below.

- i. Research and study on types of lock and locking mechanism
- ii. Design a preliminary prison door lock detector mechanism using proximity sensor, deadbolt lock, wooden door, buzzer, Arduino UNO, Xbee Pro.
- iii. Design, a graphic user interface (GUI) using Visual Studio 2013

On the other hand, the limitations of this project are

- i. The system is unable to send the message through Short Message Service (SMS) to the supervisor if he is away from the control room
- ii. The system only focuses on detection and notification system, and no automatic features such as auto-lock facilities provided

## 1.5 Significance of Research

The proposed door detection and notification, which involving wireless network can be used for real time data transmission. The monitoring system is absolutely necessary for a prison system. This can ensure that the security level of the prison is maintained all the time. Prisoners' in to and out movement from the prison cell can be observed through a monitoring system. Indirectly, the number of prison escape can be reduced. Besides that, number of manpower whom responsible for the prison cell door supervising can be minimized. By the detection and notification system, monitoring time can be lessened, as the alert will be given if a suspicious event occurred. Beyond the bounds, this proposed research is a scalable project. Many more features can be added on to it and developed. For instance, gsm module, rfid module, temperature sensor, touch sensor, heat sensor can be included in the hardware. This project can be used in the places in need for high security and surveillance system. For example, it can be commercialized to all prisons, bank locker room, defense system and luxury hotels

## 1.6 Thesis Overview

This thesis is a combination of five chapters that contain the introduction, literature review, methodology, result and discussion and the last chapter is the conclusion and recommendation of the project. Chapter 1 is an introduction to the project. This chapter will explain the background, problem statement, objectives and scope of the project. The concept behind the project and an overall overview of the project also will be discussed within this chapter. Chapter 2 tells about the literature review of the types of prison cell door lock and sensor based upon previous research done. Chapter 3 will explain about the project methodologies of the project. This chapter will show the steps and flow for problem solving in such a specific method used to design and develop the locking mechanism also the other factor and characteristic need to be focused on. Chapters 4 describe the expected result from this project and justify its performance to make sure it meets the objectives of the research. Finally, Chapter 5 concludes the whole research and proposes the future progress of the project.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter will include background study related to the proposed project. In addition, a comparison table based on each journal on the material used, advantages and disadvantages.

#### 2.2 Wireless Sensor Network (WSN)

Wireless Sensor Network (WSN) consists of low cost small devices for event monitoring such as motion, vibration, temperature or heat to accordingly forward the data over the network. It includes self-reliant sensors, remote transceiver and power supply to operate wirelessly for sensing and communication (Wang.C 2005)[18].



Figure 2.1: Basic Wireless Sensor Network (WSN) system

Wireless Sensor Network (WSN) gives a platform between the physical and virtual reality. It also allows the capacity to discover which was imperceptible before at a refined resolution over vast spatial-temporal scales which manage both space and time. WSN's potential applications[13] are for industry, civil infrastructure, transportation, science and security (Krishnamachari 2005).

### 2.3 WSN Components

There are a few key segments that help in developing a wireless sensor network (WSN). They are low-power embedded processor, memory/storage, radio transceiver, sensors, geopositioning (GPS) system and power source (Krishnamachari 2005)[13].

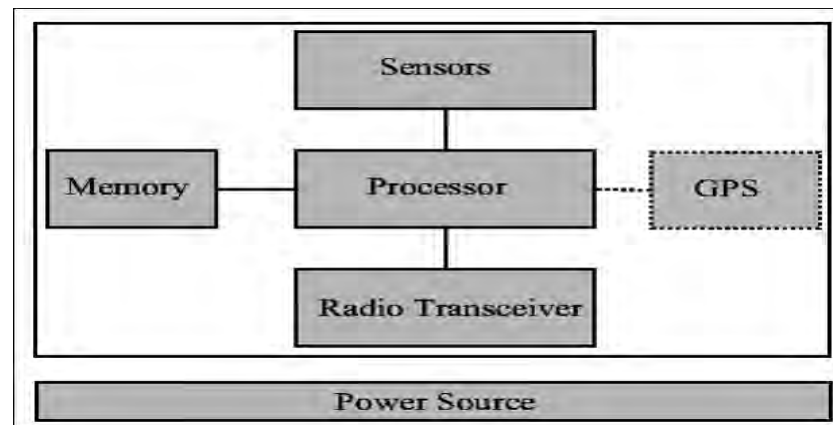


Figure 2.2: WSN's Schematic

1. Low-power embedded processor
  - Processes sensed information and communicated information.
2. Memory/Storage
  - Storage in random access memory and read-only memory
3. Radio transceiver
  - Short range (< 100m) and low rate (10-100kbps) wireless radio
4. Sensors
  - Only support low data rate sensing due to power constraint and bandwidth such as light sensors, chemical sensors and accelerometers.
5. Geopositioning system
  - Positions are preconfigured or obtained through satellite-based GPS

## 6. Power source

- Can be battery powered or given continuous power supply.

## 2.4 WSN Application

Wireless Sensor Network (WSN) has great potential in many applications. They are such as environmental monitoring, structural health monitoring, transportation, industrial monitoring, distributed temperature monitoring and so on [24]. Environmental monitoring from inspecting the uprightness of soil, air and water to directing the humidity and temperature connected with the indoor storage of basic resources like servers or perishables. Wireless technologies grow these applications by permitting you to make measurements that were not available in the past.

For structural health monitoring, specialists and researchers are utilizing the most recent detecting and estimation techniques to empower a shrewder and more secure common base for existing and new structures far and wide. Remote innovation extends these estimation methods permitting engineers to make estimations that were not available presently. Wireless Sensor Network (WSN) plays as an important platform in transportation to monitor way in and way out events that happen in parking structures, remotely transmit the information back to a base station to process the data, and send it to a database system which is web-accessible.

Industrial monitoring has the capacity to control and monitor electrical oil, water and power systems provides industries with a more financially savvy approach to quantify use progressively. This helps the industries to handle supply and for all the more viably distinguish and fix the issues and guarantee administrative and security consistence. Distributed temperature monitoring, checking and gives nonstop temperature status of high-voltage cables, identifying problem areas along their whole length. An alert is activated when temperature points of confinement are surpassed and cables are in danger. An optical fiber is utilized for temperature observing along the outside of the link. It is invulnerable to electromagnetic impedance and gives dependable temperature estimations in high-voltage situations. Information can be put away in a database for examination and reporting.