Prisoner Localisation Using RSSI Algorithm

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ABSTRACT

The Global Navigation Satellite System (GNSS) in the indoor location is impractical, thus Wireless Network based System (WNS) are widely used for the indoor and outdoor location estimation techniques. Compared to various other localisation methods, the RSSI based techniques are highly appreciated because of their minimal complexity. RSSI is used for tracking the location of the prisoner both indoor and outdoor. This RSSI detection sensor is fixed to the prisoner arm or in the wrist, so that the signal is been detected continuously. In case of any signal break, the neuro stimulator gets activated, the functioning of this stimulator is to deliver the micro shock to the prisoner, if the prisoner tries to break this sensor on his arm or wrist, then the vibration sensor gets activated , passes the trigger to the neuro stimulator, which in case will again pass the micro shock to the prisoner to be with in his bounded limits and there is no chance of possibility to escape.

Keyword: - *Global Navigation Satellite System, RSSI, vibration sensor, neuro stimulator*

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1. INTRODUCTION

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). 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

For several decades, the 2 trends 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' behaviour. 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, such as scanning devices can help to detect everything from mobile phone to a blade.

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.

2. EXISTING SYSTEM

2.1 Light Source Based Approach

Prison perimeter wall can be divided into several zones and each zone is embedded with a Laser module on one side and opposite wall would have LDR to detect the laser beam. If the prisoner attempts to approach the wall, laser beam would be interrupted, which raises an alert by sending signal to siren and sends short messages to officials. The circuit connection for interfacing Laser sensor, LDR with Arduino Uno board to process the signals sent by the light source module and enables alert system (Siren/Buzzer).

Light Source Based approach is enhanced by integrating light source module with RFID technology. Each prisoner would be wearing a RFID tag for several reasons like in-house purchasing, billing, wage calculation etc. RFID reads the tag information and notifies the officials about the prisoner who attempts to flee away from prison. Through this alert system, prisoner can be prevented from escaping from the prison.

Prison perimeter has multiple levels of wall and these perimeters walls are restricted area for any prisoner. Laser Sensor is deployed in one end of the wall and LDR is mounted on other side of the wall with 10m distance. If anyone passes through this wall to escape, this would be notified by SMS/Call service.

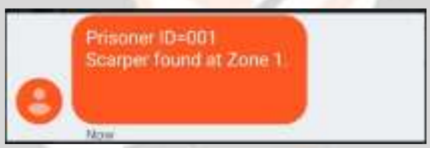

Fig -1: SMS notification to officials

If RFID technology is not included with this module, false alarm would be generated if bird flew through the regions. But this approach will not help in tracking the prisoner if he goes out of prison.

Virtual Fence is created by specifying the coordinates in Arduino IDE and appropriate package for GPS is included. Through GPS getposition () spatial coordinates are extracted and verified with fenced region. Fig -1includes the geofenced region in Arduino IDE.

If the fetched coordinates are within the boundary of the fenced region, prisoner stays inside the prison. Otherwise, prisoner have attempted to escape and immediately officials would be notified with the prison ID and current location. In Fig -2, snapshot of the SMS sent by GSM module and current location of prisoner is sent through the Google Map service information to the registered mobile number.

Fig -2: SMS notification about the prisoner current location shared with Google Maps

Among these two solutions, Geofencing based approach is found to be useful, because it provides the location information even if the prisoner is out of prison.

2.2 Geofencing Using GPS

Every prisoner would be wearing a GPS, GSM (Global System for Mobile Communications) and processor to process and determine the signals sent by GPS. Geofencing uses spatial information obtained from GPS and determine whether the user is inside or outside the perimeter. Two level of fence can be created and if any attempt to migrate from one perimeter wall to other wall, signal would be sent to GSM module. GSM would send call/SMS alert to the concerned officials. Fig -3 shows the interfacing of GPS and GSM modules with Arduino microcontroller GPS spatial information is verified for the fenced regions, if prisoner approaches innermost wall, alert system is activated and prevents the prisoner from escaping.

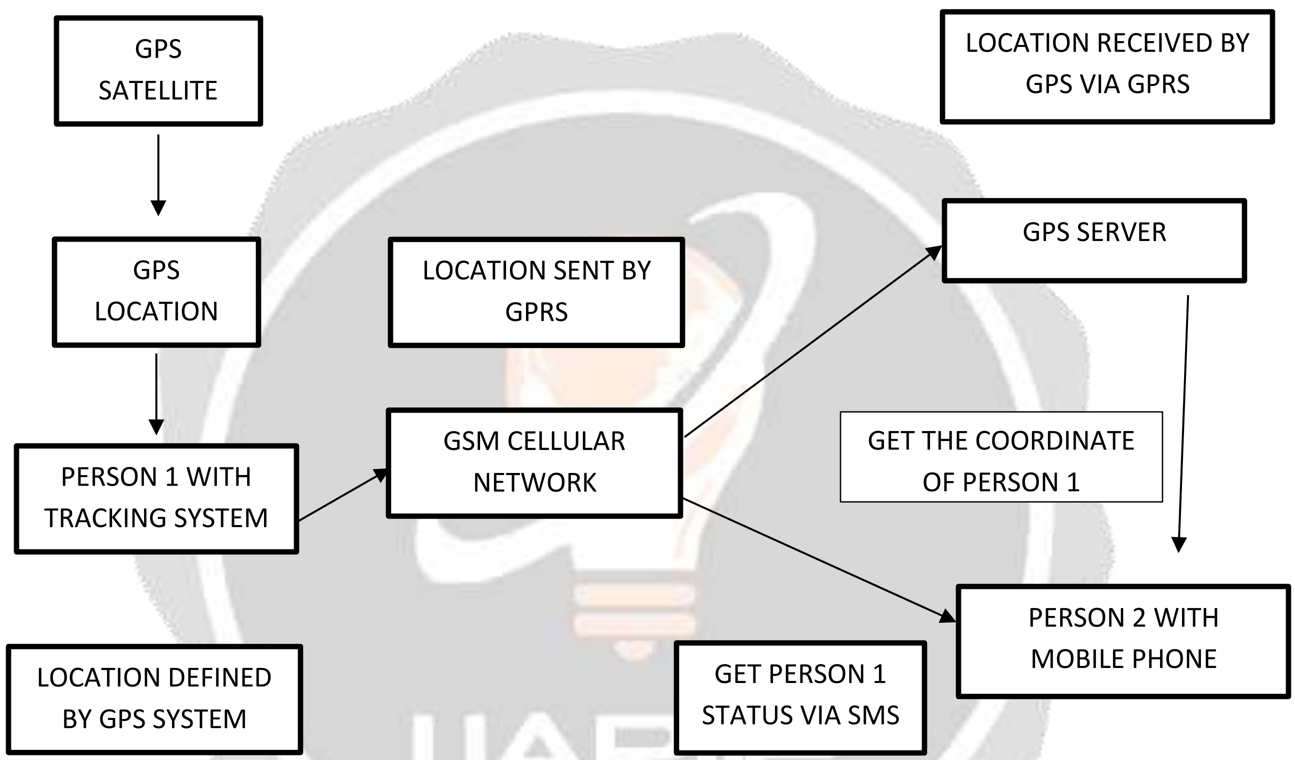

Fig -3: Interfacing of GPS and GSM Module

The idea of Geofencing using GPS can be extended to grant a restrained freedom for the prisoner those who go on parole, geofence is created for the defined area (home region/different work place). If the prisoner steps away from the defined area. Geofencing with GPS sends the current map location to the prison officials to notify about the current location along with prisoner details (Identification number). If the prisoner attempts to remove or damage the wearable device, it needs to be immediately notified. Major limitation of Geofencing approach is battery power consumption. The GPS frequently receives the spatial coordinate from satellites consumes high battery power. To conserve the energy consumption by the module, Prisoners localization using RSSI approach can be implemented.

3. PROPOSED SYSTEM

3.1 Block diagram of transmitter and receiver

In this project, an approximate initial information on the position of the tags is required, even if errors up to about 1mcan be tolerated by the algorithm. A more difficult problem, however, arises if at the beginning, the tag coordinates are completely unknown and must be estimated together with the robot pose. This kind of situation is known in the literature by simultaneous localization and mapping (SLAM). Compared with the localization literature, only a few papers deal with SLAM using the RFID technology. As pointed out in, the limited accuracy in RFID data excludes the possibility of applying well-established SLAM approaches in this context. This is particularly true when RFID tags are used as binary sensors. In this case, the SLAM is faced with specific approaches or assumptions. Using the time response of RFID tags, applied an EKF (properly initialized) to solve a SLAM problem and achieves a localization accuracy in the order of about 0.5 m. The block diagram of transmitter and receiver is shown in fig -4 and fig -5.

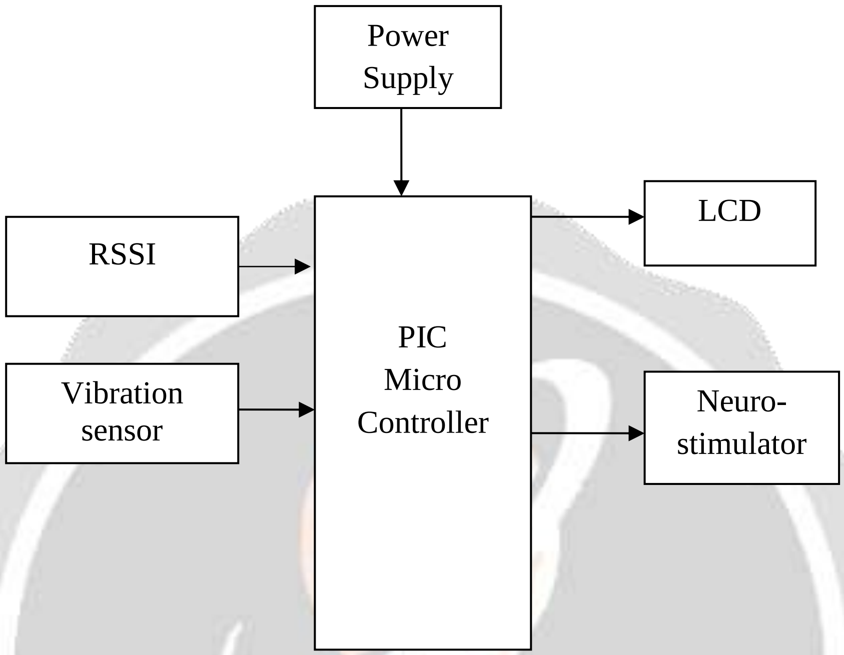

Fig -4: Block diagram of Transmitter

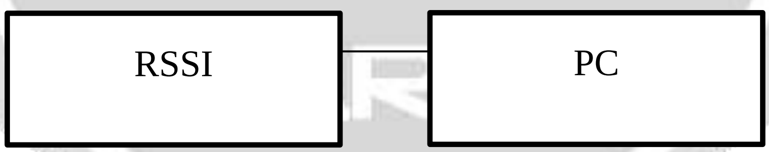

Fig -5 Block diagram of Receiver

RSSI technology is used to monitor the location and position of prisoner will always hold the RSSI Zigbee and neuron stimulator. For example, if the prisoner is try to move outside the jail it automatically indicate through buzzer in the control room based on the signal strength. The control room automatically sends a control to activate neuron simulator. If the prisoner is try to break the module is sense by vibration sensor, it will automatically produce alarm in the prisoner section and control section. The RSSI ZIGBEE inside the room reads the location and distance to the control section. In the receiver section, the data is gathered and stored in the PC for the future use. LCD will display the location and action performed by the microcontroller.

3.2 RESULTS

When the prisoner tries to break the band, it is automatically indicated through the buzzer in the control room based on the signal strength. The prisoner's movement is detected by the vibration sensor and the neuro stimulator gets activated and in turn the prisoner is subjected to shock. Then the RSSI ZIGBEE inside the room reads the location and distance and it will automatically produce alarm in the prisoner section and control section. In the receiver section, the data is gathered and stored in the PC for the future use. LCD will display the location and action performed by the microcontroller. When the prisoner exits the zone, the neuro stimulator gets activated and the prisoner gets indication through LCD as shown in fig -6.

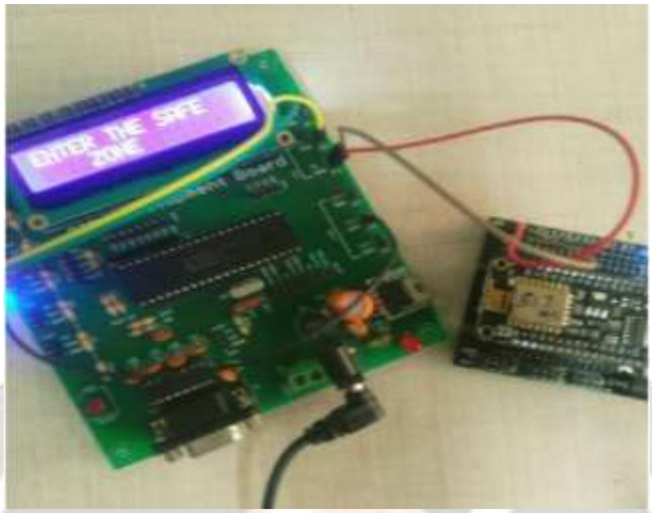

Fig -6: Output of RSSI

If the prisoner tries to break the band, the vibration is detected by the vibration sensor. The detected vibration is displayed in the LCD module as shown in fig -7.

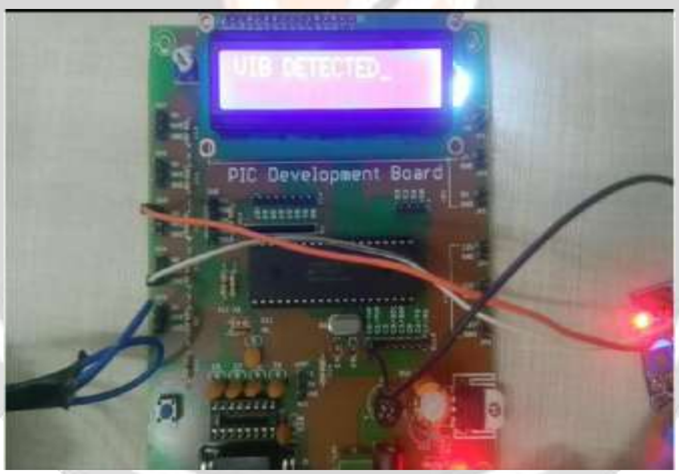

Fig -7: Output of vibration sensor

4. CONCLUSION

The RSSI and the phase can be considered two redundant measurements of the same quantity: the distance of the robot from the projection of the tag on the floor. However, the information delivered by these two quantities presents different features, for some aspects complementary: phase measurements are more sensitive than the RSSI to a change in the robot position but suffer from a cycle ambiguity, which complicates matters. The optimal combination of the two measurements is not straightforward and represents a challenging problem, dual in a sense to the problem of the dynamic allocation of redundant actuators. An effective solution is proposed in this paper by considering an algorithm characterized by two stages: in the first stage, only the RSSI is used for estimation purposes, while in the second stage, also the phase measurements are considered.

A dynamic criterion, based on the observation of the variance of the estimation of the tag coordinates, is adopted to decide the switching time between the two stages, which is performed independently on each tag. The proposed two-stage algorithm estimates the robot pose and simultaneously improves the estimate on the tag coordinates. Errors up to about 1m can be tolerated by the algorithm on the initial estimate of the tag positions. If no information is available at the beginning on the tag coordinates, range only SLAM techniques could be considered to solve the problem, capitalizing on the ideas presented in this paper to properly combine RSSI and phase measurements.

5. REFFERENCES

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