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Implementation of Hardware based System for Asset Monitoring and Tracking System

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Abstract— This system employs multiple technologies for the effective monitoring and protection of the subjected object or an asset. It is attached to the asset to be monitored and tracked in case of a theft. When the object is in its initial position, the analog voltages produced by the accelerometer, on its X, Y and Z outputs are in the normal range and those values are recorded by the microcontroller through the ADC section. Whenever someone attempts to lift or move the object being guarded, without the permission of the owner with the intension of theft, the accelerometer senses the motion and produces signals whose values are considerably different from the normal condition. The tilt might be in any or many of the axis. As the microcontroller is routinely reading these values, it senses the abnormal movement and sounds the buzzer to alert the people around and asks for presenting the RFID card, because the person could also be the owner. In case, the valid RFID card is presented, the system ignores the movement and allows the owner to handle the object as they want. If the RFID card is invalid or fake or no card is presented at all within a time period, the system sends alert SMS containing the information of its current location. The owner can then take immediate action to recover the stolen object. The owner can also, at any time send a SMS with a valid password to know the position of the object. Upon receiving the SMS, the system verifies the password and if it matches with the pre-programmed password, collects the location information and sends a reply SMS to the owner.

Keywords— Radio Frequency Identifiers (RFIDs), Wireless Sensor Network (WSN),Asset Monitoring and Tracking System, Global Positioning System (GPS).

I. INTRODUCTION

An asset is something that has potential or actual value to an organization. People throughout the world are increasingly becoming mobile; they use mobile devices such as smartphones and tablets to do their work at office, at home, and while travelling. Which is resulted to the as anytime, anywhere information workers-those who use three or more devices, working from multiple locations, and use many apps. Consequently, the traditional asset management and tracking systems have to be redesigned to cater for this as well as for bring your own device(BYOD) concept. The meantime, the availability of these devices has led to an increase in their (devices) loss through theft.

There is an increasing needs for tracking devices, which can be a life saving devices. During periods of disasters, people can use these systems to keep track of employers to

monitor where they are at all times during the workday, teenagers to control their movements, smaller children and elder when they go missing and for many other purposes. The evolution to location-dependent services and applications in wireless systems continues to require the development of more accurate and reliable positioning and tracking systems.

Considering the pros and cons, it became clear that a Radio Frequency technology will be the most appropriate communication system. It was chosen not only due to the low costs of the transmission modules, but also because it does not produce additional monthly expenses. In order to make the system more mobile than the normal RFID solution we added a GPS device to determine the position. Therefore, the data can be sent from RF devices to one central receiver thus avoiding any fixed checkpoints for determining the position.

The resulting system has the ability to monitor the presence of an object using RFID reader that pro-actively interrogates a passive tag attached to an object, detect unauthorized removal of an object under monitoring, instantly communicate security violations via cell phones, and use windows location sensors to track the position of an object using Google-maps. The system also manages administrative tasks such as manually. experiment conducted using the resulting system prototype proved the hypothesis outlined for this research.

II. Related Work

A. *mTracker: A Mobile Tracking Application for Pervasive Environment*

The use of mobile devices has become part of our daily routine. Recently, mobile devices like mobile phones or portable digital displays (PDAs) are equipped with global positioning system (GPS) receptors that allow us to get the device geographic position in real time. Through the known geographic position, this application enables the user to track a mobile device and send alerts if it is out of the radius around an interest point, previously defined by the application administrator..

The main objective of this system is to track a device according to an interest point, as well as, a security radius around it. The main objective has been fully achieved. mTracker application includes several feature, such as sending distress calls via SMS, detecting unauthorized SIM card in the device and the total capacity for system customization. To interact with both mTracker and mTrackerMap it is not necessary an advanced knowledge user or expert in tracking technology, since both applications are user friendly.

Furthermore, the use of Google Maps in the mTrackerMap application is very intuitive. Since tracking through GSM cell is not as accurate as GPS tracking, we have concluded that the tracking of the device should only be with GPS coordinates. Despite the lack of accuracy when compared with the GPS, the GSM cell tracking can be very useful since it works even when device is indoors, unlike GPS.

B. *A Tracking System Using Location Prediction and Dynamic Threshold for Minimizing SMS Delivery*

A novel method called Location-Based Delivery (LBD), which combines the short message service (SMS) and Global Position System (GPS), is proposed, and further, a realistic system for tracking a target's movement is developed. LBD reduces the number of short message transmissions while maintaining the location tracking accuracy within the acceptable range.

The LBD consist of three primary features: Short message format location prediction, and dynamic threshold. The defined short message format is proprietary Location prediction is

performed by using the current location, moving speed, and bearing of the target to predict its next location.

When the distance between the predicted location and the actual location exceeds a certain threshold, the target transmits a short message to the tracker to update its current location. The threshold is dynamically adjusted to maintain the location racking accuracy and the number of short messages on the basis of the moving speed of the target.

C. *Anti-theft Tracking System*

The system has two units. The first is security unit which is embedded in the vehicle. This unit consists of a GSM modem, GPS receiver, control relay, current sensor microcontroller. The current sensor will send an analog signal to the microcontroller when the car is running. The microcontroller will send SMS directly to the owner for confirmation. NC control relay contacts are connected with the hot line that powers the fuel pump and ECM.

The microcontroller can send a signal to the relay to cut off the power, when received SMS contains code from owner mobile to stop it. The GPS receiver retrieves the locate on information from satellite in the form of latitude and longitude readings in real-time. The microcontroller processes the GPS information and transmits it to the user uring GSM modem by SMS for every 10 minutes.

The microcontroller also reads engine parameters from vehicle data port and sends them to the second module in the same SMS. The modem receives SMS text that includes GPS coordinates, engine parameters, and vehicle engine status. This text is processed using a Visual Basic program to obtain the numeric parameters, which are saved as Microsoft Office Excel file, to transfer this information to Google Earth, the Excel file is converted to KML (Keyhole Markup Language) format. Google Earth interprets KML file and shows vehicle's location on the map. The system's efficiency is dependable on the sufficiency of the used communication network.

III. METHODOLOGY

The block diagram of the complete working prototype is shown in the figure 1. It comprises of Atmel's 89S52 microcontroller, MEMS based three-Axis accelerometer, Analog to Digital Converter (ADC), RFID Reader, GPS Receiver, GSM Modem, TTL/RS232 Converter, LCD display, Relay & Driver, Buzzer & Driver and Power supply units.

The microcontroller, acting as a small embedded, computer, control the activity of the entire system by executing the program stored in its code memory. The Tri-axial accelerometer senses the tilt in X, Y and Z directions and produces analog voltages proportional to the tilt. These analog voltages are converted to digital by ADC for enabling the microcontroller to obtain tilt vales in X, Y or Z directions. The LCD display is of 2 lines×16 characters. It is used to display various prompt messages for user interaction. TTL/RS232 level converter is for converting the voltage levels of RS232 standard voltages to TTL and vice versa. The relay connects the only available RS232 serial port with multiple serial devices viz RFID reader, GPS receiver and GSM modem according to the requirement. RFID reader is used to read the RFID tag/card of the owner. GPS receiver is used to collect the location information in terms of latitude and longitude. GSM modem is used to send alert SMS to preferred phone number that contains information of the asset and its current location.

- **RFID Card Reader: -** RFID stands for Radio Frequency Identification. The reader emits radio waves in ranges of anywhere from one inch to 100 feet or more, depending

upon its power output and the radio frequency used. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing. A transponder (RF tag) electronically programmed with unique information An RFID transponder is a special kind of radio transmitter and receiver. It is activated when it receives a signal of a specific kind. RFID transponders are present in smart cards and Radio Frequency Identification tags. The transponder, which represents the actual data carrying device of an RFID system, normally consists of a coupling element and an electronic microchip. When the transponder, which does not usually possess its own voltage supply (battery), is not within the response range of a reader it is totally passive. The transponder is only activated when it is within the response range of a reader. The power required to activate the transponder is supplied to the transponder through the coupling unit (contact less) as is the timing pulse and data.

- **GPS receiver: -** A GPS tracking unit is a device that uses the Global Positioning System to determine the precise location of a vehicle, person, or other asset to which it is attached. GPS stands for Global Positioning System, and refers to a group of U.S. Department of Defense satellites constantly circling the earth. Global Positioning System (GPS) is a network of 24 satellites that continuously transmit coded information, which makes it possible to precisely identify locations on earth by measuring distance from the satellites. Earth.. Each satellite is equipped with an atomic clock, transmitter, and computer. The purpose of using GPS module in the system is, it continuously transmits serial data like position of an individual wearing sensor, in terms of latitude and longitude, date, time and speed values to processing unit. Generally, most GPS receivers support the NMEA (National Marine Electronics Association) GPS Receivers are available as interface modules from various manufacturers. Most GPS are capable of sending information through a simple serial link. Only the TXD and GROUND pins need to be connected. The GPS must be set at 9600 bps (or 4800), 8 bits, No Parity, and 1 stop bit. The GPS Receiver proposed to be used in this system will receive all the coordinates needed from the GPS satellites. It will send the information to the microcontroller. We will be using the GARMIN model GPS 12 XL. This unit Because of its miniature size and low power operations, it can be embedded into many portable devices such as the palm, laptop computers, handheld radios, cell phones, automobile navigation systems and space navigation systems. Because of its micro-sized board, the system integrator can easily fit GPS functionality into portable products. It has the capability to refresh its data once every second and therefore will be continuously updating the inputs for the microcontroller as the object changes location.
- **Dual Band GSM MODEM: -** A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem sends and receives data through radio waves. It uses two different frequencies, one for uplink (900 MHz) and another for downlink (1800 MHz) or vice versa, depending upon the prevailing status of the network. A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer or a microcontroller through a serial cable. GSM

modems can be a quick and efficient way to get started with SMS, because a special subscription to an SMS service provider is not required. The mobile operator charges for this message sending and receiving as if it was performed directly on a mobile phone. In most parts of the world, GSM modems are a cost effective solution for receiving SMS messages, because the sender is paying for the message delivery. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate. Computers or the microcontrollers use AT commands to control modems. GSM modems support a set of standard AT commands. These AT commands are defined in the GSM standards. With the AT commands, one can do things like Reading, writing and deleting SMS messages, Sending SMS messages, Monitoring the signal strength, Monitoring the charging status and charge level of the battery, Reading, writing and searching phone book entries etc.

- **Buzzer and Drive Circuit: -** Whenever any abnormal tilt of the object is sensed by the microcontroller through the accelerometer sensor, an audio tone produced by a buzzer. The microcontroller controls the sound produced by buzzer through a drive transistor. The buzzer driver consists of an npn transistor operated in CE configuration. It supplies current to the buzzer element connected in its collector. The microcontroller sends TTL level signals, a logic '1' to turn on the buzzer and a logic '0' to turn it off
- **Power Supply Circuit: -** Power supply section has to provide a regulated D.C supply to all sections of the system. It is a regulated power supply unit to provide a constant voltage at 1 Amp current rating. It derives power from AC mains and coverts it into DC power at low voltages. It consists of a step-down transformer, rectifiers, filters and regulators. It supplies +5Volts to Microcontroller, MEMS accelerometer, ADC, RFID Reader, GPS Receiver, GSM Modem, TTL/RS232 Converter, LCD display, Relay & Driver and Buzzers.

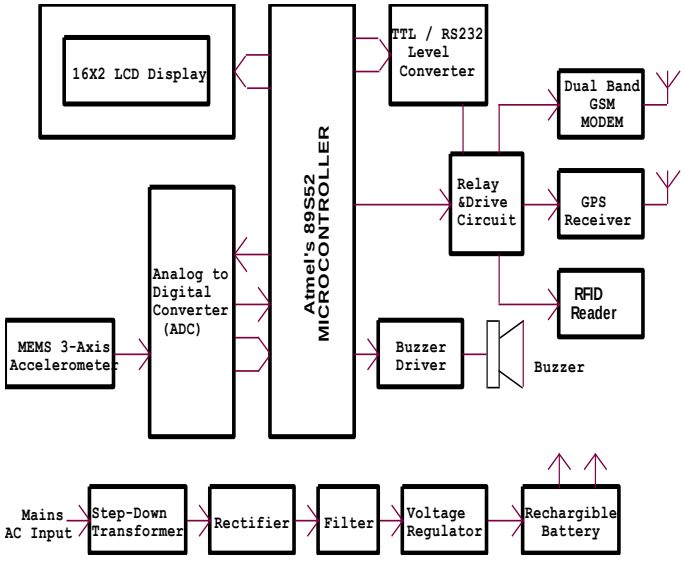

Fig. 1. Block diagram of Asset monitoring and tracking system

IV. RESULT

Evaluation of the system prototype was achieved through rigorous experimental cases conducted. The aspects of the prototype that were subjected to experiments are those that help to prove or refute the success of the proposed integration architecture and middleware design in answering the research questions that instigated this study. The elements of the system that were tested include: (1) Database stress load intended to understand the ability of the system to handle scalability and its level of responsiveness to queries during operation peak times; (2) Promptness of the prototype in detecting security breach and communication of those breaches via SMS; (3) The ability to achieve laptop tracking using Google Maps and the accuracy level of windows location sensor in providing location data acquired through Wi-Fi triangulation or scrutiny of IP address data; (4) Prototype vulnerability, in terms of the detection of deceptive actions that compromise the operation of the prototype.; (5) SMS query intelligence in delivery of geographical information; (6) Fault tolerance and system flexibility; (7) Analysis of activity logs to determine prototype malfunctions; and (8) The capability of the prototype in automating functions such as Asset Registration and Asset Assignment, which are conducted manually at the problem domain.

One of the most important aspects of the system that needed to be tested was the middleware location service's ability to accurately show a laptop's location using Google maps. Figure 3 below shows the results of the experiment conducted and how the middleware is effective in generating, processing and saving asset locus data to a database. In this experiment, one subject was asked to go into any building of his choice within the campus, but without revealing the building name or building location.

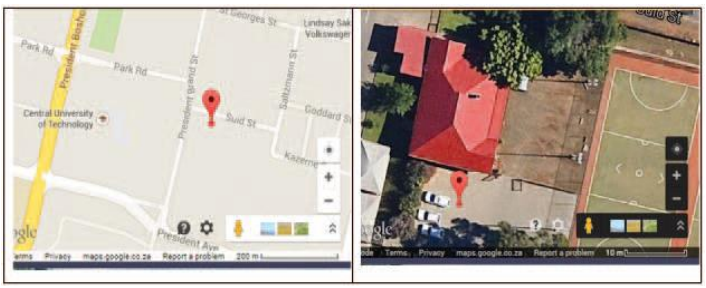

Figure 2. Location service

The results of the experiment are depicted in Figure 2 was beyond doubt able to show us the building into which the subject had gone. The building name was identified as Student Exchange house, located along Suid Street. A further experiment that was deemed paramount was to query a laptop's location using an SMS. The user simply sends a query to the system via SMS, using a specific command. The middleware then decodes the SMS query and instructs its services to trigger the respective events, which handles the user request. The results of this experiment revealed that the middleware was smart enough to translate the newly generated GPS coordinates saved on the database into a physical address. The response from the middleware comprised the following: (1) the **street name**; (2) **city** in which the laptop is; and (3) the **zip code** associated with the city. This aspect of the system, proves that if hardware manufacturers can include GPRS and GPS hardware modules in laptops, laptop owners can simply query the location of the laptop from a cell phone; hence making laptop tracking easy.

V. CONCLUSION

Nowadays, theft, kidnapping kids and missing elders has increased. So to protect our valuable things, kids and many more, we need monitoring and tracking system. Here we have used RFID with GPS and GSM chips connected to microcontroller. Many approaches are there for tracking system but the importance of our approach is it is offline and low cost device. The device we implemented need not to be stay connected to the Internet. But it need to be connected to network because whenever owner request for current location GPS gets its location via satellite and GSM forward that location to the registered phone number.

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