ABSTRACT

Indoor radio frequency tracking systems are generally quite expensive and can vary in accuracy due to interference, equipment quality or other environmental factors. Due to these limiting factors of the technology, many businesses today find it hard to justify investing in RFID tracking technologies to improve the safety, efficiency and security of their working environments. The aim of this project was to provide a budget RFID tracking system that was capable of tracking a person or object through an indoor environment. To minimize the cost of the RFID tracking system, the components of the system were built from existing electronic equipment and hardware. The software was also written to minimize licensing and support fees allowing a cost effective budget RFID tracking system to be developed. The tracking system consists of a tag, reader nodes and a PC reader which utilize synapse RF 100 engines with python scripts embedded on to the chips. The tracking system software operates through a web portal utilizing web technologies such as HTML, JavaScript and PHP to allow the tags location to be represented on a two dimensional map using scalable vector graphics. During development of the system a new trilateration algorithm was developed and used convert the signals received from the tag to a virtual position on the map correlating to the actual physical position of the tag. A unique contribution of this system is the low cost of building which we estimate as less than £200 UK sterling for a five node system.

Keywords: HTML, JavaScript, PHP, Radio, Radio Frequency, RFID

1. INTRODUCTION

Real Time Location Systems (RTLS) are becoming increasingly integrated within everyday society and large corporations. Many large businesses are benefiting from the range of functionality and cost savings that real time location systems are providing. RTLS can use a variety of technologies that are currently available such as GPS, GSM, Wi-Fi and RFID. Most of these technologies are considered inadequate for tracking people and assets within an indoor environment. The most common technology used for internal tracking systems is based on wireless technologies such as Radio frequency identification (RFID), Zigbee, Bluetooth and Wireless 802.11. Wireless offers many large and complex businesses a method of streamlining and automating many internal processes that can cuts costs, increase efficiency and revenue. Although RFID has many potential benefits and is consider quite accurate in tracking people
and assets within an indoor environment, the technology itself is considered to be expensive requiring many tags, readers and software to be purchased. Hence the technology has not been widely adopted by smaller end businesses and public sector service providers managed by the government. Many of these businesses are constrained by a budget, which is affecting their need to improve processes via investing in wireless tracking technology.

There has been many wireless indoor tracking systems developed to date, often deployed in prisons, super markets, supply chains and within the farming industry. These existing approaches all have common features and have all encountered a similar drawback that is an inherent problem with the use of wireless for tracking. There is a neglect to cater for the lower end and smaller business to improve their efficiencies and processes through the utilization of wireless tracking technologies. For wireless tracking technology to be truly widely adopted this issue must be addressed and a lower budgeted solution must be investigated and made available. The drawback is the price of the hardware components of the system, this research hopes to address and demonstrate that inexpensive and effective solution is viable.

We present here a mesh based indoor wireless tracking system that is capable of tracking a person or asset within an indoor environment. We can demonstrate here that not only the tracking software can be developed but also the wireless hardware such as the tags and readers needed to track a person or object can be built from existing hardware components. The software can be written to integrate with each of these homemade tracking components to produce an accurate and reliable wireless tracking system. Mesh networks is a LAN (usually wireless) where each node is connected to many others, configured to allow connections to be rerouted around broken or blocked paths, with the signal hopping from node to node until it reaches its destination (Kay, 2009). A wireless mesh network has advantages over other network topologies. Once set up, a wireless mesh network can manage its load to avoid clogging a certain network node. If one node becomes busy, the network traffic is redirected through other nodes, maintaining a good balance of the network load. Mesh networks can be described as self-healing, as the network will re-route data itself if a node become damaged, disconnected or blocked meaning that the network is reliable and dynamic in its approach to data routing. They rely on the same WiFi standards (802.11a, b and g) already in place for most wireless networks allowing them to be easily fitted into already existing systems using the same protocols. Wireless mesh networks are easily expanded due their node structure once a new node is added the whole network can immediately use it within its data routes.

The system outlined here is mesh based with a web-based portal that will allow the user to monitor the tags location, status and information. The purpose of building the location determination equipment is to demonstrate that an indoor tracking system does not have to be expensive and developers do not have to purchase costly premade readers or tags but that an effective wireless tracking system can be developed with a budgeted approach. This budget approach would essentially offer small to medium sized businesses an effective tracking system with an attractive price point.

2. LOCATION DETERMINATION TECHNOLOGIES

Location determination technologies are the technologies used and are capable of producing real time location systems. Real time location systems capture, process and store location specific data (Popat, 2007). This section outlines many technologies that can and are being used to today to produce people and asset tracking systems.

2.1. Mobile Cellular Systems

Mobile cellular systems can locate mobile systems (MS) by using the various methods of measuring the radio signals traveling between the mobile system and a set of fixed base stations (BS) or cellular towers. The signal measurements are first used to determine the
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