MEDI- CARRIER ROBOT

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ABSTRACT

As the pace of living is getting faster people are getting much busy and forgetful even of important things in their daily life. The unable to move category patients such as the disabled ones, partial paralyzed and old people that needs to take medication also cannot escape from the pace of city life. Many does not realize that these people are having difficulty to take medicine on time with less of other people assistant.

Hence, the research presented in this thesis attempts to solve this important issue by developing an intelligent medication monitoring and notification system that can enable patients to follow prescribed medication schedules with minimal effort. The invention of this robot attempts to provide the medication towards patients by the care taker using a chassis robotic conveyor. It can store medicine and will remind the users to take their medicine with a GSM system that sends message to the user.

ABSTRAK

Oleh kerana kadar kehidupan semakin cepat, orang semakin sibuk dan melupakan beberapa perkara yang penting dalam kehidupan seharian mereka. Orang kurang upaya, lumpuh separa dan orang tua yang perlu mengambil ubat juga tidak dapat melepaskan diri dari kadar kehidupan bandar ini. Mungkin ramai tidak menyedari bahawa pesakit sebegini mengalami kesukaran untuk mengambil ubat tepat pada masanya dengan tidak terlalu bergantung pada bantuan orang lain.

Oleh itu, penyelidikan yang dibentangkan dalam kajian ini cuba menyelesaikan masalah ini dengan membangunkan pemantauan ubat-ubatan dan sistem pemberitahuan yang pintar yang membolehkan pesakit mengikuti jadual ubat yang ditetapkan dengan bantuan yang minimum. Penciptaan robot ini cuba memudahkan proses memberi ubat kepada pesakit yang berada jauh daripada penjaga dengan menggunakan penghantar robotik casis. Ia boleh menyimpan ubat dan akan mengingatkan pengguna untuk mengambil ubat mereka dengan mengaplikasikan sistem GSM yang menghantar mesej kepada penggunanya ke telefon pintar.

CHAPTER 1: INTRODUCTION

1.0 Research Background

In the 21st century, robot is widely developed in various industries. Most of the sectors implements robotic systems in carrying out technical processes. Robotic systems have come a long way since their invention, and are getting more advanced. They can perform flawless work in short period of time and contributes in various factors such as quality, time, safety and much more.

Robots that encounter most frequently are robots that do work that are too dangerous or non-consistent job for human being. Most of them can be found in auto, manufacturing, medical and space industries. In fact, there are over a million of these types of robots working today in the world. For examples like the Mars Rover Sojourner and the upcoming Mars Exploration Rover, or the underwater man-size jellyfish robot Cyro helps human explore and collect environment data of the places that are too dangerous or impossible for human to discover.

This project proposes a wheeled robot with built in camera that would solve human problem in perform inspection under dangerous area or building. Tunnel inspection robotic car is a small designed remote control robotic car which can help tunnel inspector to perform better and convenient inspection job. There are many problems faced during inspection job such as narrow space which human are not capable to enter, damaged house which most of the structure are collapsed and radioactive area.

It became a difficult and dangerous job for inspector to enter without having enough knowledge and background information of the area for inspection. The problems mentioned above might causes insecure situation for inspector while performing maintenance or testing work. Tunnel inspection robotic car is designed to replace human especially in high risk job. Besides, tunnel inspection robotic car is useful in determine the damaged structure whether is completely collapsed or partially collapsed instead of entering by human.

A large percentage of healthcare patients fail to comply with their prescribed medication schedules. This can result in hospital and nursing home admissions, serious injury, or death. It is difficult for some patients to adhere to a complex medication regimen, because it may be too complex, or the patient may be forgetful. The research presented in this thesis attempts to provide the medication towards patients by the care taker using a chassis robotic conveyor. The invention can store medicine and will remind the users to take their medicine with GSM system.

The robotic pill dispenser is based on the principle of automatically reminding patient to take their pills on time by their caretaker. The main feature of this project is that it can transport medication towards the patients no matter how many times. This is made possible by controlling the motion of the robot using smartphone applications. The applications works with the help of Bluetooth module which is a transreceiver that communicates through radio frequency. We used Arduino Uno as our main microcontroller as it is very reliable, low cost and can be easily interfaced with multiple peripherals. A rover is also present that is controlled by a remote through radio frequencies which makes our pill dispenser movable.

Firstly we made algorithm for the automatic transported medicine. Then we designed our mechanical model and interfaced all the software part and the hardware part with it. Then we made the algorithm for the remote control and made the rover model and continued with the software and hardware interfacing. Thirdly we attached the rover section with the automatic pill dispenser which made our project a movable automatic pill dispenser which is very robust and efficient that can be used easily for providing according to their caretaker medication to patients.

1.1 Problem Statement

As the pace of living is getting faster people tend to forget what they have to do due to their packed schedule. Therefore, there are inventions such as reminder, alarm, and so on to remind them what they have to do. The focus of this scope is to the unable to move category patients and sick people. They also cannot escape from the pace of city life. Maybe many do not realize that these people having difficulty to take medicine on time with less of other people assistant.

Therefore, this prototype had come out with an invention, the "Medi – Carrier Robot". This invention helps to supply medication to patients by the care taker from a long distance. Once the care taker place a particular medication into the prepared space, the patient will receive a message regarding on their updates. The patients can transport that medication towards them using android application.

1.2 Objectives

The objectives of this project are as the following:

1. To transmit medication towards patients preferred locations.
2. To develop a system that is able to be operated using android smartphones.
3. User friendly.
4. The chassis robot is able to convey the patient's prepared medicines through simple android applications.

1.3 Project Scope

The scope of this project includes:

1. The automatic medicine dispenser able to convey SMS through GSM.
2. The chassis robot able to convey medicine in a prepared space.
3. The automatic chassis robot able to move into 4 direction using android application through Bluetooth module.

1.4 Significance of Project

This prototype is able to be used by old patients, partial paralyzed patients and several kinds of disabled people. This innovation is able to convey through user's command. It's a friendly user. This invention would be helpful for these categories of patients which consumes medication to take medication on time with less of other people attention.

1.5 Project Limitation

This prototype usage has some limitations on its functions as it can only be operated by a single user at a time and can only be under the user's control up to certain distance. Then, the application used to move the chassis robot into 4 directions can only be downloaded in an android containing smartphone.

1.6 Summary

This entire chapter was briefing about the basis of this prototype. Most of this prototype objectives and problem statement had been presented to ensure the path of this project outcome. Our project is based on creating a robotic pill dispenser. We proposed this project as it is very important to take medication on time. Most often people regardless of whether they are old or young tend to forget their medicines. Timely medication is very necessary for the cure of any disease. With the help of our project we aim to tackle the problem of timely medication.

CHAPTER 2: LITERATURE REVIEW

2.0 System Architecture

The following sections describe the detailed system architecture of the prototype. It is important to note the primary use of generic prototyping components, specifically the Arduino platform, rather than designing and fabricating custom circuits. This allowed for the development of more features, less troubleshooting, and more simplified software development in higher-level programming language.

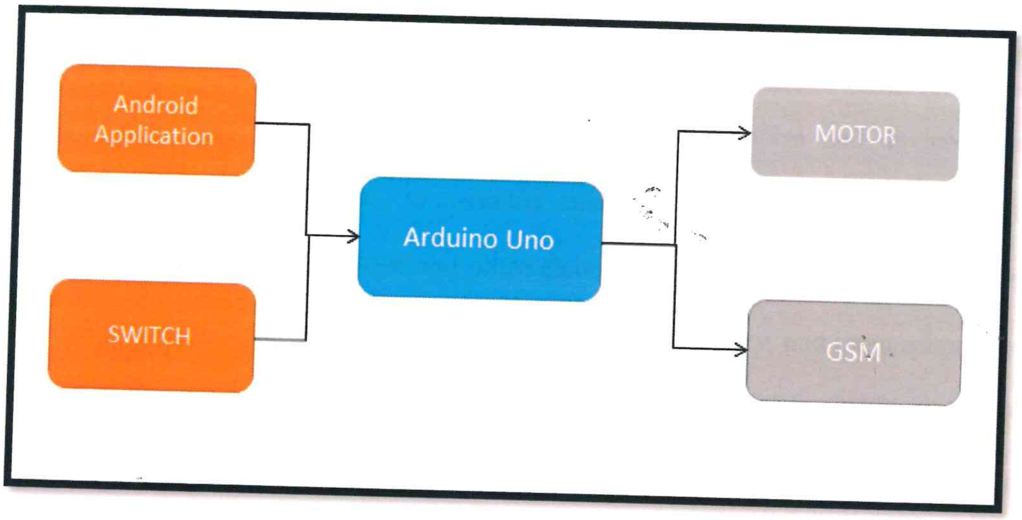

Figure 1: Block Diagram

2.0.1 Microcontroller

A microcontroller (or MCU for microcontroller unit) is a small computer on a single integrated circuit. In modern terminology, it is similar to, but less sophisticated than, a system on a chip or SoC and SoC may include a microcontroller as one of its components. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

Some microcontrollers may use four-bit words and operate at frequencies as low as 4 kHz, for low power consumption (single-digit milli-watts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nano-watts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

The microcontroller is the central processing unit for the device. It stores and executes the system software and interfaces with all of the peripheral devices. It is also responsible for backing up the system memory to persistent storage in case of a power failure or disconnect. The prototype uses the Arduino Compatible Atmel UNO with USB B type Cable (Figure 2), an open source prototyping board based on the Atmel ATmega1280 microcontroller [13]. The board includes all necessary hardware to run the microcontroller, easily access its I/O ports, provide regulated power to the microcontroller and peripheral devices, and provide a Universal Serial Bus (USB) connection to a PC for debugging and programming. This board was chosen because it is the only standard Arduino board that met the requirements for the prototype and it operates at 5 Volts (V) like the rest of the components.

Arduino UNO is one of the most famous board in Arduino family after Arduino Duemilanove. It is the latest design of the basic USB board. It comes with 6 analog inputs, 14 digitals output where 6 of them support PWM, and 16 Mhz clock speed. Arduino UNO comes with 6 analog inputs and 14 digital I/O where 6 of them are PWM outputs. It is running on an ATmega328 processor with 32kB flash memory. The clock speed of this Arduino board is 16 Mhz with the dimension of 68.6mm x 53.3mm. There are a lot of shields build to expend its functionality.

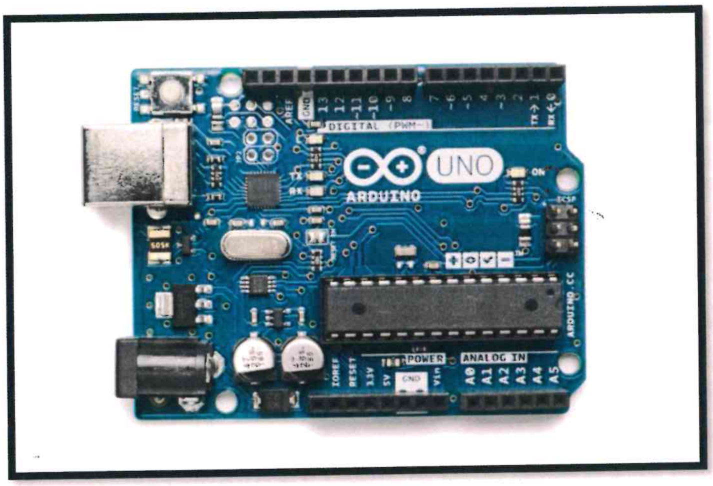

Figure 2: Arduino Uno

2.0.2 Motor Unit

A motor unit is made up of a motor neuron and the skeletal muscle fibers innervated by that motor neuron's axonal terminals. [1] Groups of motor units often work together to coordinate the contractions of a single muscle; all of the motor units within a muscle are considered a motor pool. The concept was proposed by Charles Scott Sherrington. [2]

All muscle fibers in a motor unit are of the same fibers type. When a motor unit is activated, all of its fibers contract. In vertebrates, the force of a muscle contraction is controlled by the number of activated motor units.

The number of muscle fibers within each unit can vary within a particular muscle and even more from muscle to muscle; the muscles that act on the largest body masses have motor units that contain more muscle fibers, whereas smaller muscles contain fewer muscle fibers in each motor unit. [1] For instance, thigh muscles can have a thousand fibers in each unit, while extra ocular muscles might have ten. Muscles which possess more motor units (and thus have greater individual motor neuron innervation) are able to control force output more finely. [2]

Motor units are organized slightly differently in invertebrates; each muscle has few motor units (typically less than 10), and each muscle fiber is innervated by multiple neurons, including excitatory and inhibitory neurons. Thus, while in vertebrates the force of contraction of muscles is regulated by how many motor units are activated, in invertebrates it is controlled by regulating the balance between excitatory and inhibitory signals.

In this prototype, a pair of Yellow Smart Car Robot 3v-6v Motor Dc with High Quality Wheels were used for the purpose of moving in different direction when they are controlled by the users. This full fills the requirement of our theme "Mobile Robotic" with a specific function of delivering medication to targeted people.

These two kits make creating your own robot easier than ever. Available in 2WD and 4WD versions; each kit includes motors, wheels, tires and two pre-drilled mounting plates. These kits are ideal for an Arduino or pcDuino robotics project. [3]

- Pre-Drilled mounting plates.
- One motor + gearbox per wheel.
- Motor voltage: 5-10VDC
- Dimensions:

1. KR3160 2WD 215(L) x 160(W) x 100(H)mm
2. KR3162 4WD 240(L) x 160(W) x 100(H)mm

Figure 3: Motors and Wheels

2.0.3 Global System for Mobile Communication (GSM)

GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile) is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation digital cellular networks used by mobile devices such as tablets, first deployed in Finland in December 1991. [2] As of 2014, it has become the global standard for mobile communications – with over 90% market share, operating in over 219 countries and territories. [3]

2G networks developed as a replacement for first generation (1G) analog cellular networks, and the GSM standard originally described as a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution, or EGPRS).

Subsequently, the 3GPP developed third-generation (3G) UMTS standards, followed by fourth-generation (4G) LTE Advanced standards, which do not form part of the ETSI GSM standard.

Network structure

The network is structured into a number of discrete sections:

Base station subsystem – the base stations and their controllers explained

Network and Switching Subsystem – the part of the network most similar to a fixed network, sometimes just called the "core network"

GPRS Core Network – the optional part which allows packet-based Internet connections

Operations support system (OSS) – network maintenance

Base station subsystem

GSM is a cellular network, which means that cell phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network—macro, micro, pico, femto, and umbrella cells.[4] The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average rooftop level. Micro cells are cells whose antenna height is under average rooftop level; they are typically used in urban areas. Picocells are small cells whose coverage diameter is a few dozen meters; they are mainly used indoors. Femtocells are cells designed for use in residential or small business environments and connect to the service provider's network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells.

Cell horizontal radius varies depending on antenna height, antenna gain, and propagation conditions from a couple of hundred meters to several tens of kilo-meters. The longest distance the GSM specification supports in practical use is 35 kilo-meters (22 mi). There are also several implementations of the concept of an extended cell, [12] where the cell radius could be double or even more, depending on the antenna system, the type of terrain, and the timing advance.

Indoor coverage is also supported by GSM and may be achieved by using an indoor picocell base station, or an indoor repeater with distributed indoor antennas fed through power splitters, to deliver the radio signals from an antenna outdoors to the separate indoor distributed antenna system. These are typically deployed when significant call capacity is needed indoors, like in shopping centers or airports. However, this is not a prerequisite, since indoor coverage is also provided by in-building penetration of the radio signals from any nearby cell.

GSM carrier frequencies

GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead (for example in Canada and the United States). In rare cases the 400 and 450 MHz frequency bands are assigned in some countries because they were previously used for first-generation systems. [4]

For comparison, most 3G networks in Europe operate in the 2100 MHz frequency band. For more information on worldwide GSM frequency usage, see GSM frequency bands.

Regardless of the frequency selected by an operator, it is divided into timeslots for individual phones. This allows eight full-rate or sixteen half-rate speech channels per radio frequency. These eight radio timeslots (or burst periods) are grouped into a TDMA frame. Half-rate channels use alternate frames in the same timeslot. The channel data rate for all 8 channels is 270.833 kbit/s, and the frame duration is 4.615 ms. [6]

The transmission power in the handset is limited to a maximum of 2 watts in GSM 850/900 and 1 watt in GSM 1800/1900.

Voice codecs

GSM has used a variety of voice codecs to squeeze 3.1 kHz audio into between 6.5 and 13 kbit/s. Originally, two codecs, named after the types of data channel they were allocated, were used, called Half Rate (6.5 kbit/s) and Full Rate (13 kbit/s). These used a system based on linear predictive coding (LPC). In addition to being efficient with bitrates, these codecs also made it easier to identify more important parts of the audio, allowing the air interface layer to prioritize and better protect these parts of the signal. GSM was further enhanced in 1997[14] with the Enhanced Full Rate (EFR) codec, a 12.2 kbit/s codec that uses a full-rate channel. Finally, with the development of UMTS, EFR was refactored into a variable-rate codec called AMR-Narrowband, which is high quality and robust against interference when used on full-rate channels, or less robust but still relatively high quality when used in good radio conditions on half-rate channel.

Subscriber Identity Module (SIM)

One of the key features of GSM is the Subscriber Identity Module, commonly known as a SIM card. The SIM is a detachable smart card containing the user's subscription information and phone book. This allows the user to retain his or her information after switching handsets. Alternatively, the user can also change operators while retaining the handset simply by changing the SIM. Some operators will block this by allowing the phone to use only a single SIM, or only a SIM issued by them; this practice is known as SIM locking. [6]