MOBILE ROBOT USING GPS MODULE

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Tajuk Projek : MOBILE ROBOT USING GPS MODULE

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DEDICATION

To My Lovely Mom, Late Father and Also My Happy Family

For their support and understanding

ACKNOWLEDGEMENT

بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

In the name of Allah, The Beneficent, The Merciful

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ABSTRACT

The title of this project is Mobile Robot Using GPS Module. This project intend for mobile robot moving from its current location to new location set by coordinate enter by the user. This robot consists of 3 main hardware parts which is GPS Module EM 406a, Arduino Uno R3 and servo motor. For software, it will use Arduino v1.0.1 as the compiler program code. In summary, GPS module act as GPS receiver, which detect signal from satellite and the data received is process and extract for useful information. When user enter new coordinate of location, it will calculate the distance between its current location to destination location and the distance will send to mainboard as input to servo motor to move mobile robot to destination set by the user. If GPS receiver failed to operate, the signal from satellite failed to process and the robot will not move. So it's compulsory to check the robot and the receiver status in good condition. In this project also, it is assumed there are no obstacle in the environment, so only GPS sensor use as main sensor.

ABSTRAK

Tajuk projek ini adalah 'Mobile Robot Using GPS Module'. Projek ini bertujuan, suatu robot bergerak dari lokasi semasa ke lokasi baru yang telah ditetapkan oleh pengguna apabila memasukkan koordinat. Robot ini terdiri daripada 3 bahagian utama yang GPS modul EM 406a, Arduino Uno R3, dan Motor Servo. Bagi perisian, ia akan menggunakan Arduino v1.0.1 sebagai pengkompil kod program. GPS modul bertindak sebagai penerima GPS, yang mengesan isyarat dari satelit dan data yang diterima proses dan di ekstrak untuk mendapatkan maklumat yang berkaitan tentang lokasi robot tersebut. Apabila pengguna memasukkan lokasi koordinat yang baru, ia akan mengira jarak di antara lokasi semasa ke lokasi destinasi dan jarak tersebut akan di hantar kepada bahagian utama robot sebagai input kepada motor servo untuk menggerakkan robot ke lokasi destinasi yang ditetapkan oleh pengguna. Jika penerima GPS gagal untuk beroperasi, isyarat dari satelit gagal untuk proses dan robot tidak bergerak. Jadi, ia adalah wajib untuk memeriksa robot dan status penerima dalam keadaan baik. Dalam projek ini juga, di andaikan terdapat tidak mempunyai halangan persekitaran, jadi robot akan bergerak menggunakan modul GPS hanya sebagai sensor utama.

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GPS:	GLOBAL POSITIONAL SYSTEM
PWM:	PULSE WIDTH MODULATION
NMEA:	NATIONAL MARINE ELECTRONIX ASSOCIATION
DOD:	DEPARTMENT OF DEFENSE
ALU:	ARITMETRIC LOGIC UNIT
GND:	GROUND

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CHAPTER 1

INTRODUCTION

1.1 Background Project

Mobile robot using GPS module is a combination of hardware and software project. This mobile robot will move from its current location to destination location set by the user. For introduction, a mobile robot defined as an automatic machine that is capable of movement in any given environment [11]. For these robots to be able to move in any environment they must be programmed to respond to outside environment. To do this, the mobile robot needs a specific sensor to respond to environment such as ultrasonic, ultrasound, light, colour and many more. So, in this project, GPS receivers act as sensor, so that it will send the signal to main board then move the mobile robot to certain location set by the user. A GPS receiver (GPS Module) calculates its position by precisely timing the signals sent by GPS satellites high above the Earth, then continually transmits messages that include the time the message was transmitted and satellite position at time of message transmission

Data from satellite received by GPS receiver in GPS sentences according to NMEA (National Marine Electronics Association) standard. The data need to extract so that GPS module can process and use for location of mobile robot the

next destination and location point. By using GPS navigation, the robot will move according to specific location set by the user. Distance between current and destination location can be calculate in many way, but in this project, Haversine formula used to calculate the distance. In this project, combination of movement of mobile robot and GPS navigation is program by using AVR C-Language. The robot consists of main body, using Arduino Uno main board, servo motor, wheel and GPS Module. Software using in this project is, Arduino IDE v1.0.5, and this software is use as the compiler for program codes.

1.2 Objectives Project

The objectives in this project are:

a) To extract and manipulate the data from GPS Module. In this objective, data receiver from satellite being process and extract using the NMEA standard and useful information such as latitude, longitude, UTC time, direction indicator, number of satellite used obtain.

b) To design and prototype a navigation robot and capable of navigating along a road under waypoint navigation (non-obstacle) using GPS receiver unit as its only sensor. In this project, assume the environment is non-obstacle, the mobile robot move to specific location set by user and using only GPS receiver as sensor.

c) To analyze the performance of mobile robot using GPS module. In this project also, the performance of mobile robot will analyze in term of the accuracy, whether the mobile robot can arrive to the location set by the user or not.

1.3 Problem Statement

One of the features of this mobile robot is to be able to navigate itself to certain destination. Mobile robot built using high end sensor, can implement to high risk environment. This mobile robot using low end sensor so can be implementing on low risk environment

The main problem in this project is how to move the mobile robot from its current location to destination location set by the user. To do this, the robot has to know current coordinate and the destination coordinate. In this project also, the distance between two points (current and destination) need to calculate using Haversine Formula.

1.4 Scope of Project

In this project, will focus on how to process data from satellite using GPS module, and extract the useful information for raw data. In this project also, focus to build mobile robot using Arduino Uno as the main board, the connection between GPS module and servo motor. Furthermore, other scope of this project is to use the analyzed data from GPS and modified so that can use as input to the servo motor and move the mobile robot. Last scope of this project is to analyze the performance of the mobile robot, in term of accuracy.

1.5 Importance of project

The purpose of this project to expose the project design and development concept and also as the platform for low cost mobile robot that can be implement in low risk environment such as servicing industry. So, this project implemented at lower cost compared to other mobile robot. Other than servicing industry, this project also can be used in education such as, students can add something to this mobile robot such as more sensors to detect obstacle and also do some modification of this mobile robot.

1.6 Summary of Methodology

The methodology of this project is made to achieve the objectives of this project and also to ensure it not failed the project scope.

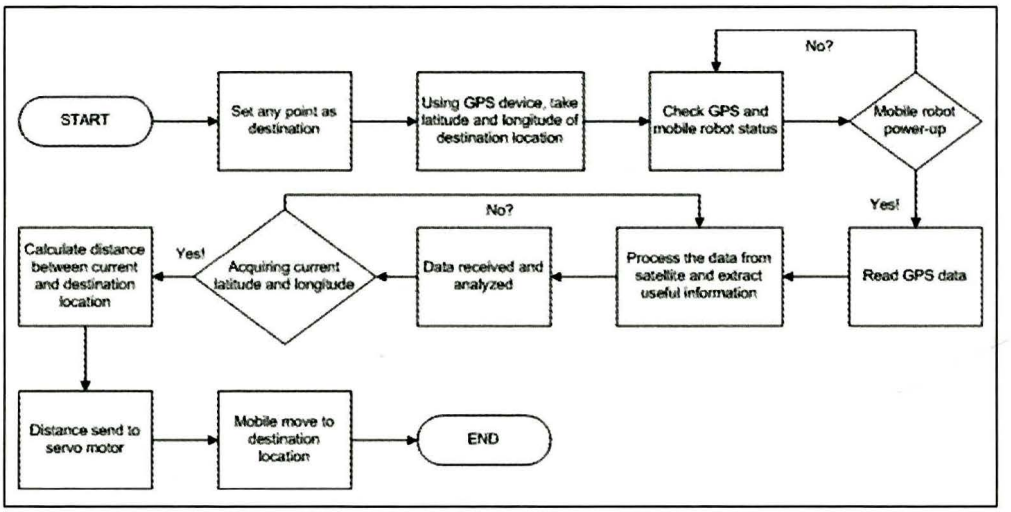

Figure 1: Workflow of this project

For starting, set any point as the destination location. Then, by using GPS device, take latitude and longitude of the destination location. Next, check the GPS and mobile status, and then power-up the mobile robot. When mobile robot ON, it automatically start read data GPS from satellite and process the data and extract useful information. It needs about 45second to lock its coordinate. After that, the data send to main board of robot and being analyze. After analyze process finish, the current coordinate obtain. Then, by using Haversine formula, its calculate distance between two points (the destination fix by the user) send the output as input to motor and lastly the mobile robot will move to the new location.

1.7 Report structure

This report consists of five chapters which are Chapter 1: Introduction, Chapter 2: Literature Review, Chapter 3: Methodology, Chapter 4: Result, and Chapter 5: Conclusion

In chapter 1 is Introduction, discussed about the project background, objectives, problem statement, scope of project, importance of this project and also summary of methodology. Chapter 2 is Literature review which is review the previous project and also all material theory and mathematical theory use in this project. Chapter 3 is all about methodology where flows process of project, the hardware and software use in this project. Chapter 4 which is discusses about the result gain from this project and also future works. Lastly, Chapter 5 is about the conclusion after completing this project and also recommendation (future works).

CHAPTER 2

LITERATURE REVIEW

2.1 Previous Relate Works

GPS technology now becomes more popular among human in case they lost or searching for something around the world. Three young student from China do some research how to match GPS track with the road in the electronic map accurately [4] using algorithm. Map matching algorithm have two processes which is firstly find the road which the car running on it and second make the GPS points projection on the road which car running on it. It finds a link in the road layer in the electronic map, this link includes the nearest point to GPS point, it calculates to this point with perpendicular algorithm. They found that there has no problem and error matching problem in the whole running process and if there happened some error matching about the 3D parking lots and highways, the algorithm can find and adjust error immediately

Other project using GPS is research by 4 students from UiTM Shah Alam [6] which is aim to GPS to locate the position of user. They also calculate the distance

between 2 points on earth using Haversine formula. In their research also, the performance of GPS receiver been analyzed at certain location such as at open space and at forest. They found that, the environment can affect the signal from satellite to GPS receiver. U.S. Patent No. 5,225,842 by Brown, Alison K., and Mark A. Sturza with title Vehicle tracking system employing global positioning system (GPS) satellites is discuss about navigation system for tracking vehicle or other object on or near the earth surface using GPS [7]. From their research, they have claimed 32 facts from their research, for example a tracking system employing global positioning system satellites for determining the position of 1 or more object to be tracked, the tracking system comprising; sensor and workstation. U.S. Patent No. 6,392,591 by William Hsu, Oliver Huang, Vincent Hung and Neil Yang with Global positioning system discuss relates to global positioning system with miniature size, reduced cost and low electrical current consumption[8]. They have claimed 3 facts which is a GPS for connecting to the external communication and processing unit comprising a receiving unit amplifying, a satellites positioning ASIC, a serial-parallel data bus and a digital interface circuit. They also claim wherein the digital interface circuit is a field programmable gate array (FPGA), an 8051 chip or a USB controller. The last they claimed is wherein the raw receiver position data is receives by the PC, mobile phone or PDA connected to a second terminus of the serial-parallel data bus.

2.2 Introduction of Global Positioning System

Global Positioning System (GPS) is a satellite-based navigation system that was developed by the U.S. Department of Defense (DoD) in the early 1970s, originally run with 24 satellites and it became fully operational in 1994 [1]. However, it was later made available to civilians, and is now a dual-use system that can be accessed by both military and civilian users. In definition, global positioning system (GPS) defined as a process used to establish a position at any point on the globe and provide specially coded satellite signals that can be processed in a GPS receiver, enabling the receiver to compute position, velocity and time, anywhere in the world under any weather conditions

2.2.1 GPS Segment

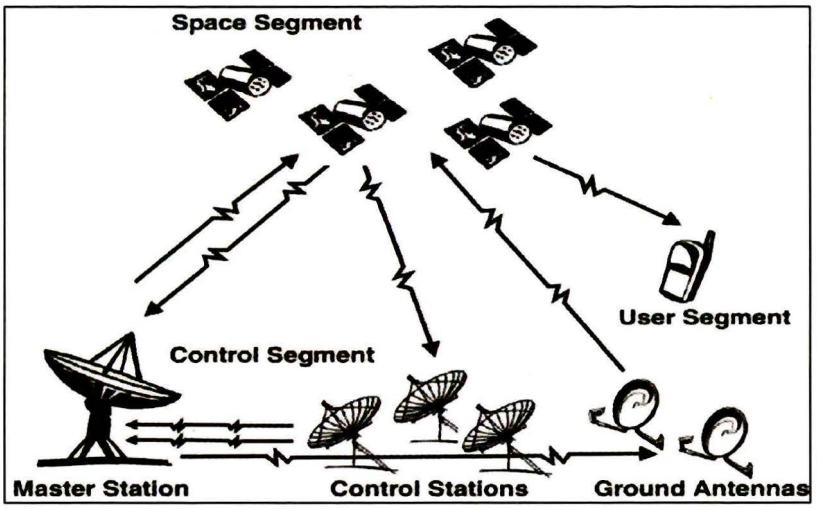

Figure 2: GPS Segment

GPS consists of three segments: the space segment, the control segment, and the user segment [3]. The space segment consists of the 24-satellite, each satellite is in orbit above the earth at an altitude of 11,000 nautical miles (12,660 miles), and takes 12 hours to orbit one time. There are 6 orbital planes each having 4 satellites. The orbits are tilted to the equator of the earth by 55° so that there is coverage of the Polar Regions. The satellites continuously orient themselves to ensure that their solar panels stay pointed towards the sun, and their antennas point toward the earth. GPS satellite transmits a signal, which is, two sine waves (also known as carrier frequencies), two digital codes, and a navigation message. The codes and the navigation message are added to the carriers as binary biphase modulations. The carriers and the codes are used mainly to determine the distance from the user receiver to thè GPS satellites. The navigation message contains, along with other information, the coordinates (the location) of the satellites as a function of time.

The control segment of the GPS system consists of a 5 worldwide network of tracking stations, with a master control station (MCS) located in the United States at Colorado Springs, Colorado. The primary task of the operational control segment is tracking the