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Utilization of IoT for Monitoring of Goods Delivery

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Abstract. *The development of computer technology has been so rapid, encouraging authors to take advantage of these developments to conduct research on monitoring the entire fleet of vehicles used to deliver and pick up goods in a business company. Monitoring is seen as very important to ensure that goods sent or taken to support business processes are carried out according to a predetermined schedule. This is to avoid disruptions in the process of sending or picking up goods that can harm the company or harm consumers. This monitoring device utilizes IoT technology, where every fleet is installed with Arduino microcontrollers, GPRS modules, and GPS modules, where the Arduino microcontroller module will send locations every minute using a GPRS connection to a server inside the company, then the server will record all record the location of the existing fleet of vehicles. With the travel records of the entire fleet, it will be easier for the company to monitor and provide assistance to the process of sending or picking up goods in the event of disturbances in the middle of the trip. The author's server side application utilizes open source applications, namely mysql database, apache web server, and PHP programming language.*

Keywords: *Monitoring, microcontroller, arduino*

1. INTRODUCTION

With the advancement of economic growth, it encourages many companies to compete to develop their business. One of them is the company where the author conducted this research. In this company, the process of sending and receiving goods from consumers is very important, because from there, the time of collection and delivery determines the level of trust with consumers. With the increasing number of consumers who entrust the delivery and receipt of goods in this company, it is encouraging to entrust the entire process of sending and receiving goods through this company. With the increasing number of consumers who use the services of this company, their income will automatically increase. One of the interesting parts of the author to conduct research is to ensure the process of sending and receiving goods from consumers to companies on time. This section is the monitoring section by the supervisor of each worker who gets the task of taking and receiving goods. The author in this case utilizes IoT which is placed in the company's vehicle, by using the IoT device, all vehicle travel activities will be easily tracked or monitored, so that interference can be prevented that can hinder the timeliness

in the process of taking and sending goods to consumers. One of the IoT devices that the author uses is the Arduino ESP 8266 as shown in Figure 1.

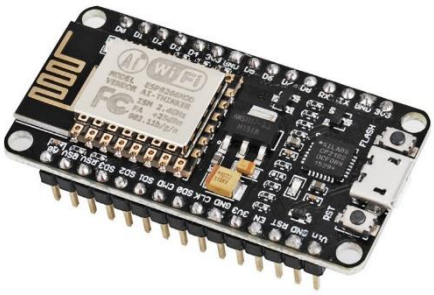

Figure 1. Arduino ESP8266(Harsapranata, 2020)

2. LITERATURE REVIEW

1.1 Internet of Things (IoT)

According to Wikipedia, "Internet of Things (IoT) is a system of machines or computer devices that can be connected between mechanical machines and digital machines, objects, animals, and people who are given a unique identity (UID) and the machine's ability to transfer data through computer network media with requires no assistance or direct human-to-human or human-to-computer interaction. The definition of the Internet of Things has evolved due to the development of several technologies, real-time data communication, machine learning, the development of sensors, and systems that are already installed in the device or often referred to as the Embedded System".(Wikipedia, 2020b)

1.2 Arduino

Arduino is a hardware and software company that uses open source applications, a community of projects and users who design, develop using single-device microcontroller kits and microcontroller kits to build digital devices. Its products are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), which permits any development, modification, manufacture of Arduino boards and distribution of the software by anyone. Arduino boards are commercially available in preassembled form (not yet assembled) or as do-it-yourself kits.(Oby, 2017)*.The device design of the Arduino system uses a variety of microprocessors and controllers. The system is equipped with a pin port used for input / and a pin port used for output (I / O) both digitally and analogously that can be connected to various circuit expansion systems with other functions. The system board has communication interfaces including serial, including Universal Serial Bus (USB) on various models, which can also be used to enter computer programs that have been configured according to user needs into the microcontroller memory. Microcontrollers can be programmed using the C programming language or using C ++. In addition to using traditional compiler applications, the Arduino project provides an integrated development system (IDE).The first Arduino project started in 2005 as a training program intended for students at the Interaction Design Institute Ivrea Italia, which aims to provide an inexpensive and easy to understand way for beginners and professionals to create devices or systems, which can interact with their environment using sensors. and the action of the sensor. Common examples of such IoT devices aimed at novice enthusiasts include simple robots, thermostat sensors, and motion detectors. The name Arduino comes from a bar in Ivrea, Italy, where some of the project founders used to meet and discuss regarding its development.*(Wikipedia, 2020a)

1.3 SIM800L GSM Module

Accoding to LastMinuteEngineers, "SIM800L GSM/GPRS module is a miniature GSM modem, which can be integrated into a great number of IoT projects. You can use

this module to accomplish almost anything a normal cell phone can; SMS text messages, Make or receive phone calls, connecting to internet through GPRS, TCP/IP, and more! To top it off, the module supports quad-band GSM/GPRS network, meaning it works pretty much anywhere in the world." (LastMinuteEngineers, 2021)*. At the heart of the module is a SIM800L GSM cellular chip from SimCom. The operating voltage of the chip is from 3.4V to 4.4V, which makes it an ideal candidate for direct LiPo battery supply. This makes it a good choice for embedding into projects without a lot of space.SIM800L Module Hardware Overview - LED Indicator, u.fl Connector, Helical Antenna.All the necessary data pins of SIM800L GSM chip are broken out to a 0.1" pitch headers. This includes pins required for communication with a microcontroller over UART. The module supports baud rate from 1200bps to 115200bps with Auto-Baud detection.The module needs an external antenna to connect to a network. The module usually comes with a Helical Antenna and solders directly to NET pin on PCB. The board also has a U.FL connector facility in case you want to keep the antenna away from the board.SIM800L Module Hardware Overview - Micro SIM Socket, Direction to Insert SIM. There's a SIM socket on the back! Any activated, 2G micro SIM card would work perfectly. Correct direction for inserting SIM card is normally engraved on the surface of the SIM socket.*(LastMinuteEngineers, 2021)*. SIM800L devices that the author uses as shown in Figure 2.*

Figure 2. SIM800L (LastMinuteEngineers, 2021)

1.4 GPRS

According to Wikipedia ,"General Packet Radio Service (GPRS) is a packet oriented mobile data standard on the 2G and 3G cellular communication network's global system for mobile communications (GSM). GPRS was established by European Telecommunications Standards Institute (ETSI) in response to the earlier CDPD and i-mode packet-switched cellular technologies. It is now maintained by the 3rd Generation Partnership Project (3GPP)". GPRS is typically sold according to the total volume of data transferred during the billing cycle, in contrast with circuit switched data, which is usually billed per minute of connection time, or sometimes by one-third minute increments. Usage above the GPRS bundled data cap may be charged per MB of data, speed limited, or disallowed.GPRS is a best-effort service, implying variable throughput and latency that depend on the number of other users sharing the service concurrently, as opposed to circuit switching, where a certain quality of service (QoS) is guaranteed during the connection. In 2G systems, GPRS provides data rates of 56–114 kbit/sec. 2G cellular technology combined with GPRS is sometimes described as 2.5G, that is, a technology between the second (2G) and third (3G) generations of mobile telephony. It provides moderate-speed data transfer, by using unused time division multiple access (TDMA) channels in, for example, the GSM system. GPRS is integrated into GSM Release 97 and newer releases.(Wikipedia, 2021a)

1.5 Global Positioning System (GPS)

According to Wikipedia, The Global Positioning System (GPS), originally Navstar GPS, is a satellite-based radionavigation system owned by the United States government and operated by the United States Space Force. It is one of the global navigation satellite systems (GNSS) that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Obstacles such as mountains and buildings block the relatively weak GPS signals.The GPS does not require the user to transmit any data, and it operates independently of any telephonic or internet reception, though these technologies can enhance the usefulness of the GPS positioning information. The GPS provides critical positioning capabilities to military, civil, and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver. The GPS project was started by the U.S. Department of Defense in 1973, with the first prototype spacecraft launched in 1978 and the full constellation of 24 satellites operational in 1993. Originally limited to use by the United States military, civilian use was allowed from the 1980s following an executive order from President Ronald Reagan after the Korean Air Lines Flight 007 incident. Advances in technology and new demands on the existing system have now led to efforts to modernize the GPS and implement the next generation of GPS Block IIIA satellites and Next Generation Operational Control System (OCX). Announcements from Vice President Al Gore and the Clinton Administration in 1998 initiated these changes, which were authorized by the U.S. Congress in 2000. During the 1990s, GPS quality was degraded by the United States government in a program called "Selective Availability"; this was discontinued on May 1, 2000 by a law signed by President Bill Clinton.The GPS service is provided by the United States government, which can selectively deny access to the system, as happened to the Indian military in 1999 during the Kargil War, or degrade the service at any time. As a result, several countries have developed or are in the process of setting up other global or regional satellite navigation systems. The Russian Global Navigation Satellite System (GLONASS) was developed contemporaneously with GPS, but suffered from incomplete coverage of the globe until the mid-2000s. GLONASS can be added to GPS devices, making more satellites available and enabling positions to be fixed more quickly and accurately, to within two meters (6.6 ft). China's BeiDou Navigation Satellite System began global services in 2018, and finished its full deployment in 2020. There are also the European Union Galileo positioning system, and India's NavIC. Japan's Quasi-Zenith Satellite System (QZSS) is a GPS satellite-based augmentation system to enhance GPS's accuracy in Asia-Oceania, with satellite navigation independent of GPS scheduled for 2023. (Wikipedia, 2021b)

3. RESEARCH METHODS/METHODOLOGY

In this study, the author uses the theory of the SDLC (System Development Life Cycle) model in making monitoring devices for sending and receiving goods from and to consumers. In this SDLC model, the author uses the Waterfall SDLC, where in the model the stages that must be carried out are: Requirements Analysis, Design, Implementation, Verification, Maintenance, in the description as shown in Figure 3.

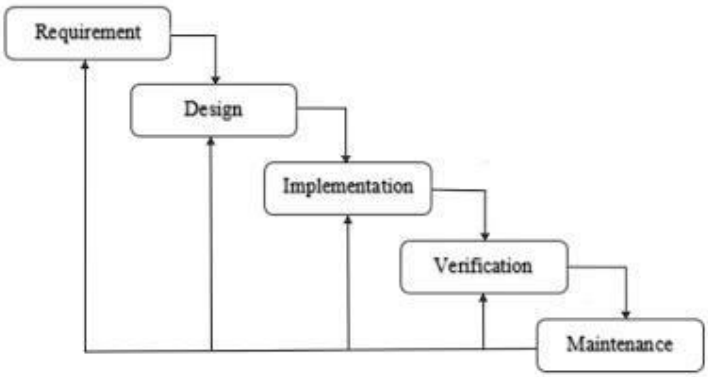

Figure 3. Waterfall model. (Harsapranata, 2020)

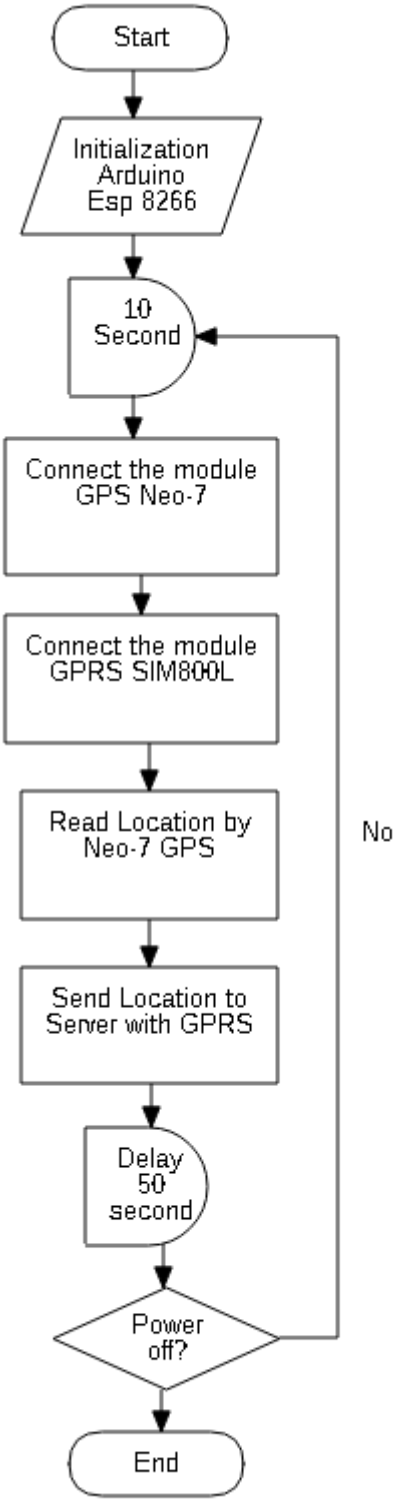

Figure 4. Flowchart System Diagram

The stages in the SDLC Waterfall carried out by the author:

1. Requirements Analysis
   At this stage the authors conduct a needs analysis that is used to support the operational needs of the system to be made. The author collects information about the equipment needed in this system, including GPS Neo-7 Module, GPRS SIM800, Arduino ESP8266, and power supply devices.

2. Design
   At this stage the author makes a system plan that is in accordance with the needs of monitoring vehicles used in retrieval and delivery of goods. The work system steps of the device that the author designed are as shown in the flowchart diagram in Figure 4.

3. Implementation
   At this implementation stage, the author translates the steps of the system running from flowchart diagrams into a programming language that can run all devices to be able to work according to the steps described in the flowchart.

4. Verification
   At this verification stage, the author tries the system that has been created, here the author tests each existing stage, as shown in the flowchart diagram in Figure 4, whether all stages are going well as expected or not.

5. Maintenance
   In the last stage, namely maintenance, the author makes observations on the system that has been made, then compares it with the system that is already running, is there still a difference, or there are stages that need to be perfected, the author evaluates so as to create a system that is truly in accordance with the company's expectations .

4. RESULTS AND DISCUSSION

In the use of IoT in monitoring vehicles from and to consumers, Latitute data and Longitude data can be sent properly every minute to the company server, as shown in Figure 5, is the appearance of the information system that displays the location of the vehicle, and if you click on the Location on button map, you will see a display on the map of the last vehicle position, as shown in Figure 6.

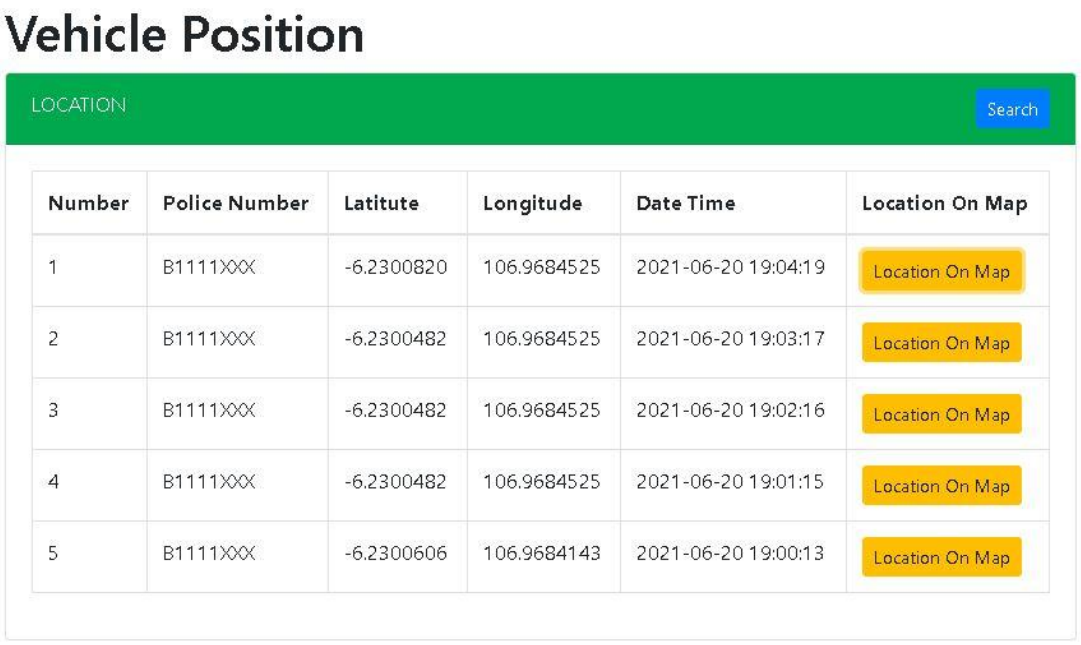

Figure 5. Vehicle location information system

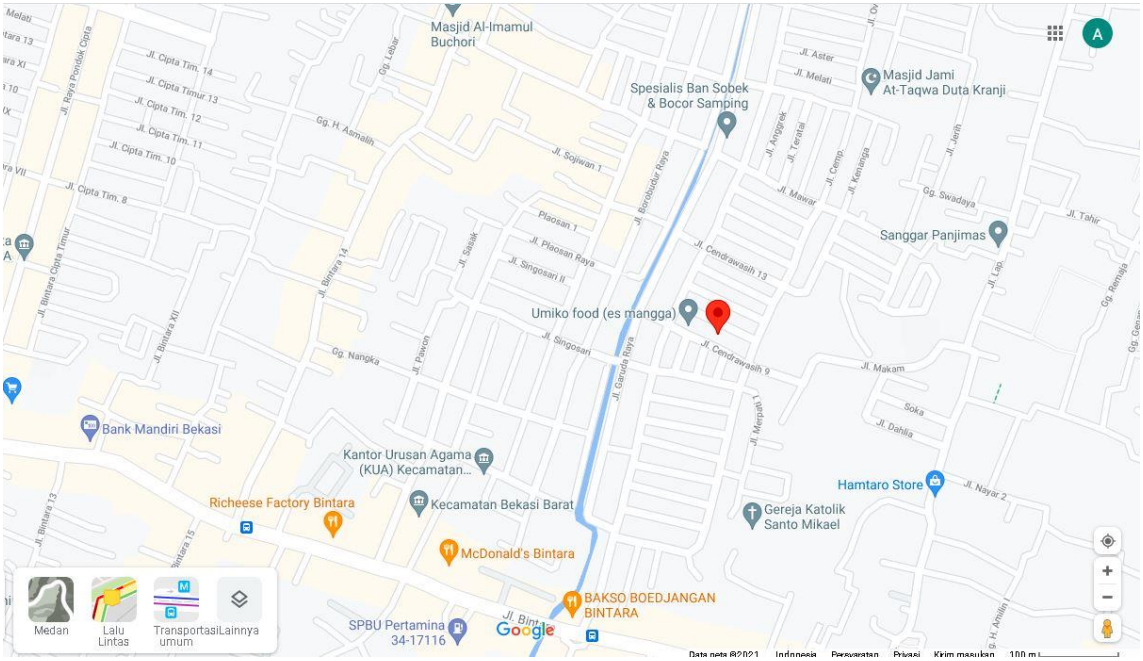

Figure 6. Vehicle Location Visible on Map

CONCLUSION

In this study the authors conclude that by utilizing IoT, and an internet connection, it can help companies monitor the location of vehicles quickly, so that they can take necessary precautions if there are disturbances in the middle of the trip.

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