Sehubungan dengan data/pembicaraan email dengan editor/publisher tidak lagi dapat ditelusuri, rangkaian/rekaman dari awal mengikuti konferensi dan publishing agreement dijelaskan sebagai berikut:

1. Acceptance of full paper and invitation to conference (1 Agustus 2019)
2. Submitted full paper for conference (5 November 2019)
3. Paper for journal (ID 5637)
4. Submitted for journal
5. Revised (1)
6. Revised (3)
7. Publishing agreement (30 Desember 2019)
8. PUBLISHED 30 Agustus 2020

International Conference
Science, Engineering & Environment (SEE)

1st August 2019

Paper ID Number: 5637

Dr. Aleksander Purba
aleksander.purba@eng.unila.ac.id

Subject: **Acceptance of Full Paper and Invitation to the 5th International Conference on Science, Engineering & Environment, Bangkok, Thailand 11-13 Nov. 2019**

Dear Dr. Aleksander Purba,

We are pleased to inform you that after careful review and assessment, the Technical Committee of SEE-Bangkok 2019 has accepted your full paper entitled "DESIGN AND IMPLEMENT A MONITORING SYSTEM OF TRAFFIC SIGNAL USING MICROCONTROLLER DEVICES" for "Oral" presentation at the conference. It is, therefore, with great pleasure that we extend our formal invitation to you to participate and present your paper at this conference.

Please make sure that you register before 15th July 2019 for your paper to be included in the conference proceedings and to be evaluated for Best Paper Award. This is strictly necessary for logistics and smooth operation of the conference. We appreciate online registration using the following link:
https://www.confsee.com/registration.htm

Guidelines for preparing oral or poster presentations are available on the conference web page: http://www.confsee.com

Should you require more information, please do not hesitate to contact us. We look forward to hearing from you soon. Please always refer paper ID number in any communication to us.

Sincerely yours,

Dr. Zakaria Hossain, Conference Chairman
5th International Conference on Science, Engineering & Environment (SEE),
Professor, Mie University 1577 Kurima Machiya-cho, Tsu-city,
Mie 514-8507 Japan, E-mail: editor@geomate.org
Tel & Fax: +81-59-231-9578
URL: http://www.confsee.com, E-mail: conference@geomate.org

DESIGN AND IMPLEMENT A MONITORING SYSTEM OF TRAFFIC SIGNAL USING MICROCONTROLLER DEVICES

Aleksander Purba[1], Rahayu Sulistyorini[1], Agung Ilhami[1] and Ageng Sadnowo Repelianto[1]
[1]Faculty of Engineering, University of Lampung, Lampung Indonesia

ABSTRACT

This project focused on designing traffic signal monitoring tools, based on ideas and concepts developed previously. Authors used the Arduino Nano module with ATmega328P as the microcontroller, which was chosen because it simplifies the scenario of traffic signal anomalies, short messages service (SMS) news content, and time settings. A microcontroller was used to process data from the interference detection result, and processing the SMS content, therefore, it is able to quickly inform the types of traffic signal disruptions. Based on result findings it is possible to utilize this development in building an integrated traffic signal monitoring system services, in the form of mobile applications in the near future.

Keywords: Monitoring system, Traffic signal, Microcontroller, Malfunctioning, Short message service

INTRODUCTION

Traffic signal infrastructure is responsible for assigning the right of way to vehicular and pedestrian passage at intersections. Meanwhile, its management and operations requires the proper design, location, operation and maintenance, to provide safe and efficient movements. A lot of mysteries surround its mechanism of action, although they are relatively simple as the installation comprises of traffic signal heads, detection and a controller, which is the 'brains' behind the equipment, containing the information required to force the lights through various sequences. These signals run under a variety of modes, dependent on location and time of day, which under fixed time operation, displays green to each approach for the same amount of time per cycle, regardless of the traffic conditions.

This may be adequate in heavily congested areas, while instances where a lightly trafficked side road is included within the sequence, the system becomes very wasteful, as no vehicles are waiting in some cycles, and the time could be better allocated to the busier approach. Vehicle actuation is one of the most common modes of operation, and as the name suggests, it takes into account demands on all approaches and also adjusts the green time accordingly. Furthermore, the requirements to actualize this mechanism are registered through the detection installed, either in the carriageway or above the signal heads, which the controller processes and further allocates the green time in the most appropriate way.

However, minimum and maximum periods are specified, and this cannot be violated, therefore, a vehicle passing a detector demands a certain phase and once that phase is green, any subsequently passing automobile, causes the phase to extend. This continues as such up to the point where either the traffic demand ceases and another approach gains green, or a conflicting demand causes the maximum timer to count down. Moreover, while vehicle actuation mode is more responsive than fixed time it also has the propensity of being inefficient in instances where long queues build up on conflicting approaches. The setting of maximum timers is then difficult due to changes in traffic patterns through junctions over time, which should therefore be regularly updated, in order to maintain effective operation. This is a labor intensive task for a local transportation authority, which is often not undertaken, thus leading to the signals becoming less effective over time.

As all electronic equipment, these devices are subject to breakdowns, malfunctions, and power outages, which could lead to safe intersections becoming dangerously congested and confusing, therefore resulting in needless accidents. However, a study on the city of Boston calculated that simply reconfiguring the timings of 60 intersections in one district of the city could save US\$1.2 million per year, in terms of person-hours, safety, emissions, and energy costs [1]. In situations where malfunctioning occurs, the entity responsible for maintaining the signal may be held accountable, as regions and municipalities have a statutorily imposed duty, which ensure roads are safe for users. Furthermore, the Province of Ontario has set up certain minimum requirements for the maintenance of roadways, which include standards related to traffic signals, according to Regulation 239/02, which states the Minimum Maintenance Standards for Municipal Highways, under the Municipal Act. However, section 13 of the O.Reg 239/02 stipulates that in cases where a

malfunctioning traffic control signal system occurs, the minimum guideline is to "deploy resources as soon as practicable after the awareness of the defect, in order to commence repairs or replacements" [2]. Meanwhile, most regions and municipalities have no statutory in this regards as Ontario, and due to the fact that most of the traffic signals are categorized as isolated intersections, the surveillance system is therefore highly dependent on road users report. Hence, response time needed is longer, especially during out of work hours.

This project focused on designing traffic signal monitoring tools, based on ideas and concepts developed from the research conducted by Sivarao et al. [3] and Anita Ahmad et al. [4], as well as self-diagnosis techniques, using the Reed-Solomon Codes by Tang and Wang [5]. Furthermore, a monitoring system with Proteus advancement tool, developed in Africa, was also used [6]. However, activities including designing concepts, materials selection, assembling tools, and traffic signal monitoring systems testing are rarely performed.

RESEARCH METHODOLOGY

The product was designed based on electronic circuit plan, where all blocks were arranged on the project board and tested individually, and also a combination on printed circuit board (PCB) was conducted, at periods of proper function. This study used the Arduino Nano module with ATmega328P as the microcontroller, which was chosen because it simplifies the scenario of traffic signal anomalies, short messages service (SMS) news content, and time settings.

This also facilitates programming, possesses a memory capacity that is capable of accommodating program scripts, it is affordable, readily available, and is relatively small in size.

However, programming was carried out using the built-in Arduino IDE open-source software, and the general description of electronic circuit design is seen in Fig. 1 as developed previously [7, 8, 9].
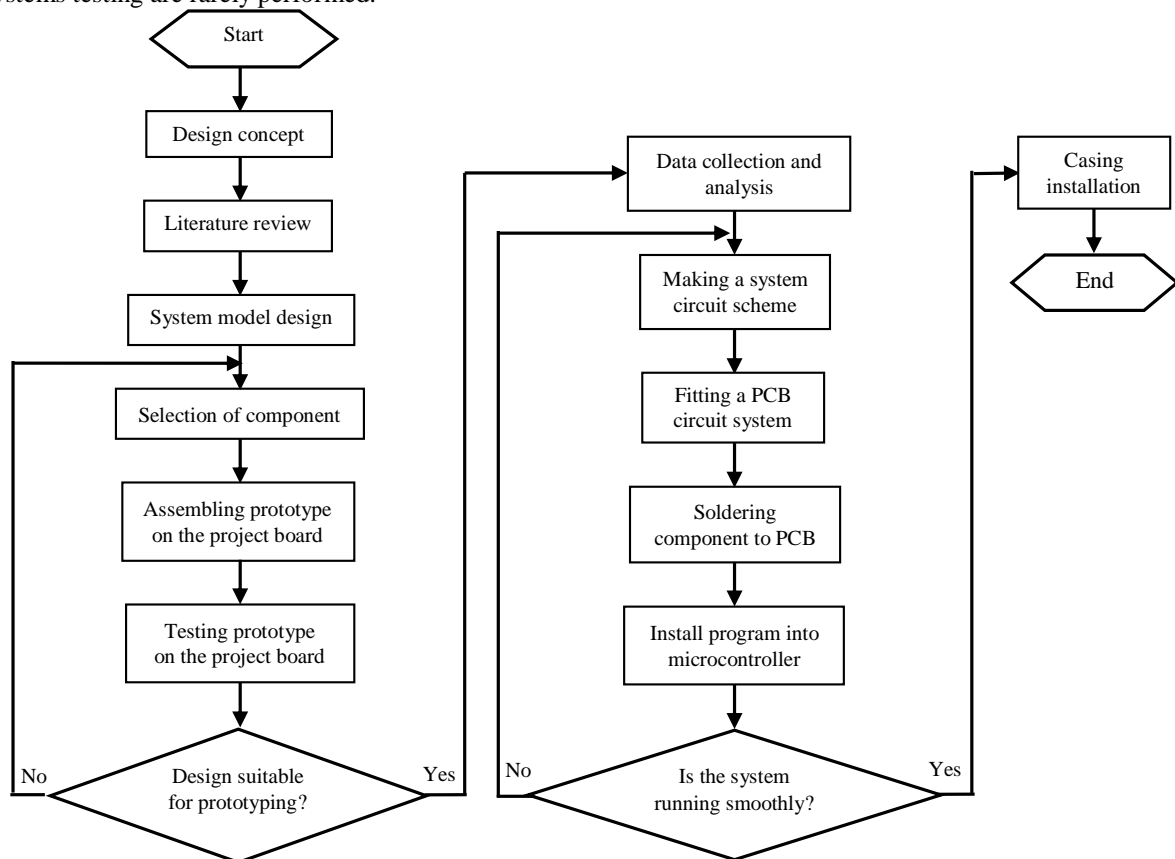

Fig. 1 Design circuit flow chart

RESULT AND DISCUSSION

Each traffic signal display is equipped with a form of light sensor, positioned in a way, in order to detect beams from the traffic signal. This is then processed by the logic gate and microcontroller to be diagnosed, based on the rational state, guard time and verification of the programming anomaly scenario. Furthermore, the microcontroller recognizes the anomaly and immediately turns all traffic signal display (red, yellow and green) off. Meanwhile, during the termination process, the microcontroller instructs the A6 GSM module to dispatch an SMS, at certain time

intervals, according to the program (e.g., once every hour). Therefore, the emergency light flashes periodically, serving as a visual marker, which indicates that the signal is under repair. Hence, mobile or smartphones can be used as an SMS receiver by entering the recipient's number from the traffic signal in the microcontroller program.

Switching mode power supply (SMPS) with DC 12V 10A voltage was used as the main source. This voltage was chosen to supply the relay and a series of LED lights on the traffic display and emergency flash. In addition, step-down DC to DC buck converter was also applied by reducing the DC 12 Volt voltage from SMPS to DC 5V 3A, which was further used to supply logical state, guard time, data latch, reflected light sensor, GSM A6 module, and the microcontroller as shown in Fig. 2.
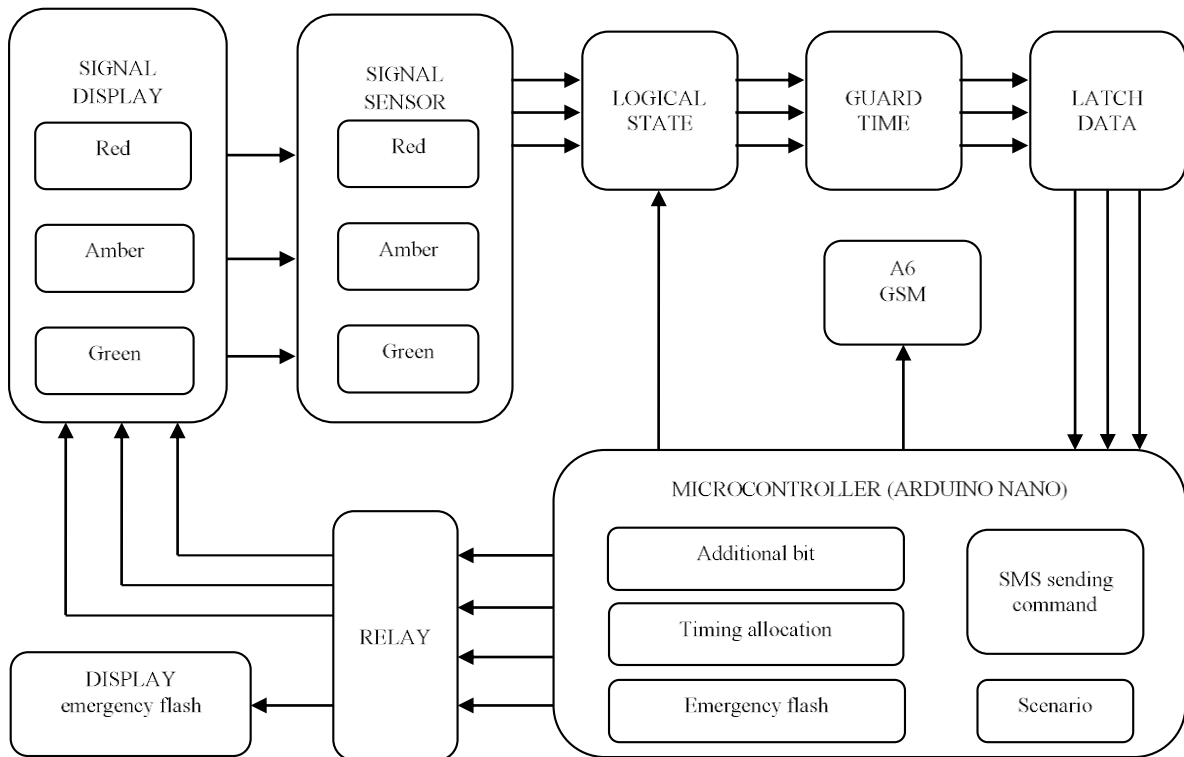

Fig. 2 Devices diagram block

Referring to Fig. 2, a design of electronic series consists of some blocks:

1. The traffic signal display block consists of the combination of a series of light emitted diode (LED) illuminations (red, amber and green), and placed between them are three light dependent resistor sensors (LDRs), used to detect reflections produced by LEDs and other reflectors.

2. The emergency flash display block consists of a combination of LED beams, functioning as visual markers, and the main traffic signal, during the repair process.

3. Reflection sensor block. The readings of each LDR (red, amber, and green) are entered into three voltage comparator circuits. Therefore, if it obtains reflected light, the sensor produces a LOW logic, and on the contrary, a HIGH logic is emitted in the absence of reflected light.

4. The logical state block is an electronic path, which uses an integrated circuit (IC) type CD4028 (BCD to decimal decoder), designed to identify different bits of each sequence of statement traffic signals, in cases of anomaly. Furthermore, the input pin of this IC is a 4-bit binary number (from 0000 to 1111), while the output pin is represented by 10 digits (Y0 to Y9). The following are some identity bits designed for each traffic signal anomaly statement:

4.1. the red display is given the 0101-bit, characterized by pin Y5.

4.2. the amber demonstration specifies the 0011-bit, represented by pin Y3.

4.3. the green exhibition is allotted the 0111-bit, denoted by pin Y7.

5. Guard time block: Anomalous data Y5, Y3, and Y7 cannot be considered valid when in the guard time series, which was allotted a time period of 1 second in this study. For example, if Y5 sends an

under-1 second-anomalous signal, it is not considered an anomaly and vice versa.

6. Latch data block: After the validity of the anomaly signal has been considered, the block is then locked (latch). This is further processed by the microcontroller, at the end of a cycle of traffic signal.

7. Microcontroller block: This is divided into five sub-blocks with their respective functions, including:

7.1. timing traffic signal functions as a time allocator per cycle.

7.2. Provision of additional bit function for CD4028 IC input (logical statement block), in determining bit during an anomaly.

7.3. Anomaly data verification scenario, through the process of matching results of processing data latch blocks with anomalous scenarios, which have been programmed in the microcontroller.

7.4. SMS sending command, when a change in the traffic signal anomaly was considered a malfunction (through the verification process) to be forwarded as news to the A6 GSM module block.

7.5. emergency flash: This sub-block works by flashing, depicting a sign that the main traffic signal is under maintenance.

8. The GSM block A6 module works by sending SMS on the processing results, from the microcontroller to the operator. This occurs because the unit has been recognized by the Arduino library, therefore, it is easily programmed in the IDE, with the AT command instruction set.

9. Relay block is a series, consisting of 4 types of transmissions, while the ULN2803A IC and opto-coupler turns ON or OFF the traffic signal display and emergency flash. These conditions for the four types of relay, follow the order of the microcontroller sub-block timing functions.

The traffic signal cycle in this study followed the sequence as shown in Fig 3.

1. Red OFF, Amber ON, Green OFF;
2. Red ON, Amber OFF, Green OFF;
3. Red ON, Amber ON, Green OFF;
4. Red OFF, Amber OFF, Green ON;
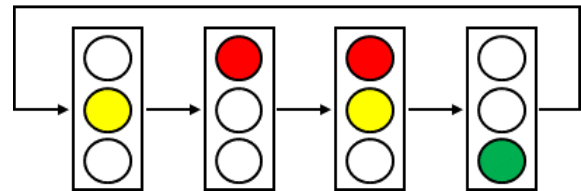5. The second cycle (restarts from Red OFF, Amber ON and Green OFF).

Fig. 3 Traffic signal cycle

Hence, the implementation of a monitoring system completely as combined work of Fig. 1 and Fig. 2 respectively, shown in the Fig. 4 below.
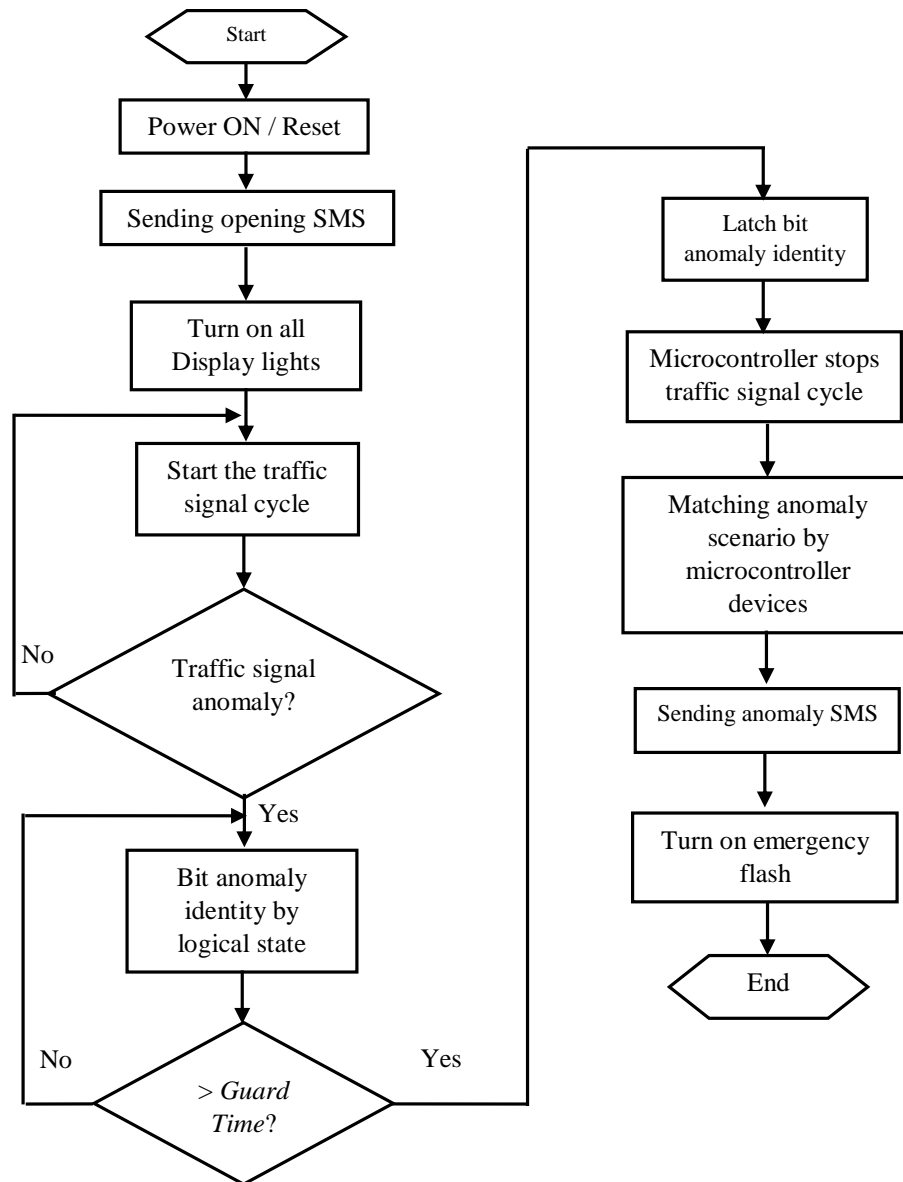
```
                    ┌─────────────┐
                    │    Start    │
                    └─────────────┘
                           │
                           ▼
                  ┌─────────────────┐
                  │ Power ON / Reset│
                  └─────────────────┘
                           │
                           ▼
                  ┌──────────────────┐
                  │Sending opening SMS│
                  └──────────────────┘
                           │
                           ▼
                  ┌─────────────────┐
                  │  Turn on all    │
                  │ Display lights  │
                  └─────────────────┘
                           │
                           ▼
                  ┌─────────────────┐
                  │ Start the traffic│
                  │  signal cycle   │
                  └─────────────────┘
                           │
                           ▼
        No          ◇───────────────◇
       ◄────────────  Traffic signal
                    │   anomaly?    │
                    ◇───────────────◇
                           │ Yes
                           ▼
                  ┌─────────────────┐
                  │   Bit anomaly   │
                  │  identity by    │
                  │  logical state  │
                  └─────────────────┘
                           │
                           ▼
        No          ◇───────────────◇   Yes
       ◄────────────   > Guard Time?  ────────►
                    ◇───────────────◇
```

Fig. 4 Flow chart of signal monitoring system

CONCLUSION

This research highlights the ability to autonomously diagnose traffic signal device systems, especially in its work function, with the intent to detect interference on the device, and provide report via short message service (SMS) to a monitoring unit. Furthermore, this can be placed in any area covered by the Global System for Mobile Communication (GSM) wireless communication service. Meanwhile, a microcontroller was used to process data from the interference detection result, and processing the SMS content, therefore, it is able to quickly inform the types of traffic signal disruptions. Hence, it is possible to utilize this development in building an integrated traffic signal monitoring system services, in the form of mobile applications.

ACKNOWLEDGMENTS

REFERENCES

[1] Boston Transportation Department. The benefits of retiming/rephasing traffic signals in the Back Bay, 2010.

[2] http://www.cityofboston.gov/images_documents/The%20Benefits%20of%20Traffic%20Signal%20Retiming%20Report_tcm3-18554.pdf

[3] Sivarao, S. K. Subramanian, M. Ezro and T. J. S. Anand, Electrical & Mechanical Fault Alert Traffic signal System Using Wireless Technology, International Journal of Mechanical & Mechatronics Engineering IJMME-IJENS, August, 2010, 10(4), pp.15-18.

[4] M. Z. A. Marzuki, A. Ahmad, S. Buyamin, K. H. Abas and S. Hj. M. Said, Fault Monitoring System for Traffic signal, Jurnal Teknologi (Science and Engineering), 2015, 73(6), pp. 59-64.

[5] X. Tang and S. Wang, A Low Hardware Overhead Self-Diagnosis Technique Using Reed-Solomon Codes for Self-Repairing Chips, IEEE Transactions on Computers, October, 2010, 59(10), pp. 1309-1319.

[6] P. I. Okwu, E. S. Mbonu, C. G. Ezekwe and C. U. Ajuzie, Quick Prototyping of Real Time Monitoring System Using Proteus Development Tool: A Case for Self Diagnostic Traffic signal System, December, 2013, 6(5), pp. 147-154.

[7] P. Aleksander, S. Rahayu, S. R. Ageng and I. Agung, Developing Monitoring System of Traffic Signal Using Microcontroller Device by SMS of GSM Network, Proceeding of Seminar Nasional SINTA FT UNILA, 2018, Vol. 1, pp. 273-277.

[8] F. K. Rasha, Traffic Light Control System Using Microcontroller, AL-Qadisiyah Journal of Pure Science, 2018, 23(2), pp. 269-280.

[9] T. A. Kareem and M. K. Jabbar, Design and Implementation Smart Traffic Light Using GSM and IR, Iraqi Journal for Computers and Informatics, 2018, 44(2), pp. 1-5.

SEE Bangkok 2019 papers for Journal publication

Paper ID number	First Name	Last Name	Paper Title
5331	SALEM	ALSANUSI	STUDY OF SEEPAGE THROUGH AN EARTH DAM CASE STUDY
5506	SAAD	ALABDULLAH	ECONOMICAL ANALYSIS OF THE GEOGRID REINFORCED RAILWAY TRACK
5507	Felix T. S.	Chan	A STOCHASTIC MODEL OF THE MRO SPARE PARTS PROCUREMENT PLANNING PROBLEM FOR AIRCRAFT MAINTENANCE SERVICE PROVIDER
5508	Wattana	Wirivutthikorn	DIFFERENT RATIOS OF OKRA JUICE AND PANDAN LEAF JUICE ON SPORT DRINK
5510	RADHI	ALZUBAIDI	A COMPUTER PROGRAM FOR EVALUATING RESSUREMETER TEST RESULTS OF CLAY
5513	Gemala	Pritha Ryzki Rynjani	ESTIMATING PEOPLE'S TRAVEL BEHAVIOUR TOWARDS TRANSIT-ORIENTED DEVELOPMENT IN DUKUH ATAS, DKI JAKARTA PROVINCE
5514	Ken-ichi	Fujita	A STUDY ON HUMAN DAMAGE IN EVACUATION FROM TSUNAMI CONSIDERING STREET-BLOCKADES CAUSED BY DESTROY OF BUILDINGS
5516	Anucha	watanapa	ANALYSIS OF PROBLEMS AND SOLUTIONS IN THE HEAT INSULATING GLASS MANUFACTURING INDUSTRY USING FMEA
5518	Fatmah	Fatmah	DEVELOPING AGE-FRIENDLY CITY: CASE STUDY FROM DEPOK
5519	Takayuki	Hayashi	APPLICATION OF DEAGGREGATION OF SPATIAL PROBABILISTIC SEISMIC HAZARD TO DISASTER PREPAREDNESS
5521	Tetsuya	Ohmura	A CONCRETE WALL ELEMENT TEST TO EVALUATE COM-PRESSIVE FRACTURE ENERGY
5525	Bambang	Istijono	THE EFFECTS OF BATANG KANDIS RIVER MOUTH TO FLOOD CONTROL IN PADANG CITY-PALAPA METROPOLITAN AREA
5527	Hiroshi	Higashiyama	FATIGUE STRENGTH OF HEADED STUDS WELDED WITH IMPROVED FERRULE IN CONCRETE UNDER UNIDIRECTIONAL CYCLIC LOADING
5528	Boonthum	Wongchai	DESIGN AND ANALYSIS OF FORMULA SPACE FRAME CHASSIS WITH SIDE IMPACT
5529	Leonard	Johnstone	PUBLIC TRANSPORT INITIATIVES IN WEST AFRICA, A CASE STUDY OF ABIDJAN
5530	Bambang	Setiawan	PRELIMINARY RESULTS OF SITE-SPECIFIC GROUND RESPONSE ANALYSIS
5532	SALEM	ALSANUSI	ANALYSIS OF SLOPE STABILITY (AJDABIYA RESERVOIR)
5533	Lasha	Asanidze	ABOUT KARST (CHEMICAL) DENUDATION IN ZEMO IMERETI PLATEAU. GEORGIA, CAUCASUS
5534	Nazar	Oukaili	PREDICTION OF FLEXURAL STRESS IN UNBONDED POST-TENSIONED STEEL AT DIFFERENT LOADING STAGES
5536	Panida	Chaiming	RESEARCH AND DEVELOPMENT OF PILLOW FOR HEALTH IN THAI PEOPLE: A PILOT STUDY
5537	Irina	Mashkova	BIOMONITORING OF WATER POLLUTION IN LAKE CHEBARKUL BY THE CONTENT OF HEAVY METALS IN MACROPHYTE ORGANS, RUSSIA
5538	Pairaya	Sitthiracha	GROUND REACTION FORCE OF STEP MARCHING:A PILOT STUDY
5539	Yulvi	Zaika	THE DURABILITY OF LIME STABILIZED EXPANSIVE SOIL
5540	Shama	Haque	THE IMPACT OF URBANIZATION ON THE WATER QUALITY OF UTTARA LAKE, DHAKA – A CASE STUDY.
5541	Patcharapol	Posi	DURABILITY OF CONCRETE CONTAINING RECYCLED ASPHALTIC CONCRETE AGGREGATE AND HIGH CALCIUM FLY ASH
5542	JUNTIP	NAMSAWANG	THE EFFECTS OF COMBINED ELECTRICAL STIMULATION WITH SHORT FOOT EXERCISE ON MEDIAL LONGITUDINAL ARCH AND INTRINSIC FOOT MUSCLE SIZE: A PILOT STUDY
5543	Aprisal	Aprisal	EFFECT OF LAND MANAGEMENT OF HORTICULTURAL TO SOIL ERODIBILITY AT THE UPSTREAM OF SUMANI WATERSHED

5544	Supamas	Sriwongpuk	A NEW REPORT OF ARGULUS INDICUS (CRUSTACEA: BRANCHIURA) INFESTATION IN RED TILAPIA (OREOCHROMIS NILOTICUS X OREOCHROMIS MOSSAMBICUS) IN THAILAND
5545	Zhen	Xiao	IMMEDIATE EFFECTS OF ARM SWING EXERCISE THERAPY ON THE RANGE OF SHOULDER MOTION AND STAND POSTURE: A PILOT STUDY IN YOUNG ADULTS
5546	SAWAT	PIMSUWAN	THE EFFECTS OF WATERING RATES USING THE DRIP IRRIGATION METHOD ON THE ROOT MASS GROWTH OF BIRD'S NEST FERNS
5548	Akio	Nishida	THE INFLUENCE OF HEAVY METALS AND MAJOR IONS IN STREAM WATERS, RUNNING IN SERPENTINE, LIMESTONE, AND CLOSED-MINE AREAS, ON MACROINVERTEBRATE COMMUNITIES, KINKI AND CHUGOKU, JAPAN
5549	Masahiro	Yoneda	WALKING AUTHENTICATION BASED ON POWER SPECTRUM DENSITY OF ACCELERATION AT LUMBER PART
5551	Victory	Pogodina	LANDSCAPE OPPORTUNITIES AND PREFERENCES FOR CHOOSING RECREATIONAL PLACES OF MEGALOPOLIS RESIDENTS (ON EXAMPLE OF ST. PETERSBURG)
5553	THI NGUYEN HAO	TRAN	EFFECT OF SAIL CONTENTS ON COMPRESSIVE STRENGTH OF DMM IN SALINITY CLAY SOFT SOILS FOUNDATION IN VIETNAM
5554	Suphattharachai	Chomphan	CORRELATION BETWEEN VIBRATION SIGNALS AND SOUND SIGNALS OF A PERSONAL CAR WITH GASOLINE ENGINE
5557	Ahmad	Zubair	ANALYSING THE INFLUENCE OF COGNITIVE, AFFECTIVE, CONATIVE AND MOTIVATION ASPECTS ON TRAIN PASSENGER'S DEVIANT BEHAVIOUR: COMMUTER LINE, INDONESIA
5558	Satoe	Suzuki	STRESS ANALYSIS OF EMBANKMENTS DUE TO DIFFERENCES IN CONSTRUCTION CONDITIONS
5559	Pattrawan	Pattaranit	COMPARISON OF INTRAOCULAR PRESSURE CHANGES AFTER VIEWING LAPTOP COMPUTER AND TABLET COMPUTER: A PILOT STUDY
5560	Seiya	Nagaoka	INVESTIGATION OF OPTIMAL CONTACT TYPE ULTRASONIC COLLECTING DEVICE FOR MEASURING ROUGHNESS USING AERIAL ULTRASONIC SENSOR
5561	Pattanasak	Chaipanna	EXPERIMENTAL INVESTIGATION OF RESPONSE OF SEGMENT LINING DUE TO ADJACENT PILE LOADING
5562	Pornanan	Boonkorn	THE CRUDE TANNIN EXTRACTION FROM WOOD SCRAP WASTES FOR PROLONGING THE SHELF LIFE OF LITCHI FRUITS
5563	Phakawat	Lamchuan	HIGHLY ACCURATE ESTIMATION OF DAILY SUSPENDED SEDIMENT LOAD USING MULTIVARIATE HYDROLOGICAL
5565	Nutthanun	Tatchananusorn	IMMEDIATE EFFECTS OF THAI MASSAGE ON GAIT SPEEDS AND BALANCE PARAMETERS IN ELDERLY
5566	Angkhana	Chuajedton	EXTRACTION OF PECTIN FROM PEANUT SHELL WASTE WITH HEATING IN COMBINATION WITH ULTRASONIC-ASSISTED EXTRACTION
5567	Vittaya	Punsuvon	EFFECT OF COMBINATION MICROWAVE AND OVEN DRYING ON THE CHEMICAL PROPERTIES OF CRUDE PALM OIL OBTAINED FROM DIFFERENT OIL PALM FRUIT RIPENESS
5569	Kenji	Yoshida	FATIGUE STRENGTH OF HEADED STUDS UNDER ROTATIONAL SHEAR LOADING FORCUSING ON WEIGHT REDUCTION OF STEEL-CONCRETE COMPOSITE BRIDGE DECK
5570	Nidaa Adil	Jasim	A COMPARISON STUDY BETWEEN CHEMICAL COAGULATION AND ELECTRO-COAGULATION PROCESSES FOR THE TREATMENT OF WASTEWATER CONTAINING REACTIVE BLUE DYE
5572	Sukanya	Chaipong	INDOOR PLANT SPECIES SURVIVAL UNDER DIFFERENT ENVIRONMENT IN INDOOR VERTICAL GARDEN
5573	Heidy Octaviani	Rachman	THE CONSIDERATIONS FOR URBAN DESIGN REGARDING THE PRESENCE OF ONLINE TAXI BIKE

5575	Armeinita	Octavia	SERVICE QUALITY GAP ANALYSIS OF WATER SUPPLY IN URBAN AREAS: WATER SUPPLY COMPANY, KABUPATEN BOGOR
5576	JARUWAN	CHUTRTONG	ISOLATION OF HEAVY METAL DEGRADABLE HALOPHILIC BACTERIA FROM SOIL IN SAMUT SAKHON PROVINCE, THAILAND
5579	Dwinanto	Suberlian	FACTORS AFFECTING COMMUNITY PERCEPTION AROUND BETAWI CULTURE TOURISM ACTIVITIES SETU BABAKAN JAKARTA SELATAN
5582	Adichai	Pornprommin	LABORATORY EXPERIMENT OF CHANNEL HEAD BIFURCATION BY RADIAL OVERLAND FLOW
5583	Bambang	Istijono	IDENTIFICATION OF DRAINAGE SYSTEMS CAPACITY USING EPA-SWMM 5.1 VERSION MODELING IN GUNUNG PANGILUN OF PADANG CITY-PALAPA METROPOLITAN AREA
5584	Yoshihiro	KABEYAMA	SIMULATION OF THE COLLAPSE PROCESS OF INFRASTRUCTURE USING GENERAL-PURPOSE PHYSICS ENGINE
5587	Thaned	Satiennam	MOTORCYCLE-RELATED DEATHS AND HELMET USAGE SITUATION IN THAILAND
5589	Seiichiro	Fukushima	STUDY ON SEISMIC LOAD ON BUILDINGS CONSIDERING RESIDUAL RISK
5591	Pornpailin	Boonna	QUALITY OF VERMICOMPOST BY PHERETIMA PEGUANA FOR DIFFERENT ORGANIC BASE MATERIALS
5592	Ambar	Pertiwiningrum	EVALUATION OF METHANE AND CARBON DIOXIDE EMISSIONS FROM LIVESTOCK WASTE, COMPOST, AND BIOGAS SLUDGE
5593	Norikazu	Sakaba	CONSTRUCTION OF DAMAGE FUNCTION FOR AN ANALYSIS OF THE ECONOMIC DAMAGE BY EARTHQUAKES WITH A FOCUS ON THE RECONSTRUCTION OF SHARED HOUSING
5594	Katsuyuki	Kawai	GROUND SURVEY BASED ON THE DISTRIBUTION OF SURFACE WAVE VELOCITY AND ELECTRICAL RESISTIBILITY
5597	Keiichiro	Shibata	STUDY ON ELUTION REDUCTION OF HEXAVALENT CHROMIUM FROM RECYCLED BASE COURSE MATERIAL USING WASTE SYRUP
5599	Titin	Siswantining	GEOINFORMATICS OF TUBERCULOSIS (TB) DISEASE IN JAKARTA CITY YEAR 2017
5602	Suttinee	Likhittragulrung	EFFECTS OF CHLORINE DIOXIDE DIPPING ON PERICARP BROWNING REDUCTION OF LONGAN FRUIT
5604	Kouichi	Takeya	BASIC STUDY ON BRIDGE WEIGH-IN-MOTION USING OPTICAL FLOW ANALYSIS
5609	albano	ajuda	EFFECT OF REINFORCEMENT STIFFNESS ARRANGEMENT ON SEISMIC PERFORMANCE OF GEOGRID REINFORCED SOIL WALLS
5610	Satia Nisa	Firdhauzi	SPATIAL AND TEMPORAL PATTERN OF SOIL CONSERVATION IN MOUNTAIN ECOSYSTEM: CASE STUDY OF PATUHA MOUNTAIN, WEST JAVA - INDONESIA
5611	Ranti	Hidayawanti	THE IMPACT AGGREGATE QUALITY MATERIAL AS LINEAR REGRESION STUDY ON MIXTURE CONCRETE
5612	Dewi	Susiloningtyas	SPATIAL DISTRIBUTION OF RESTAURANT POPULARITY INDEX BASED ON CONSUMER REVIEW WEBSITE IN JAKARTA
5616	Yoko	Sakakihara	DEVELOPMENT OF A MICROBIAL-BASED GROUTING MATERIAL WITH CALCIUM CARBONATE PRECIPITATES
5618	Wanwarang	Pattanapo	EFFECT OF ELECTROLYZED REDUCING WATER ON CARBENDAZIM SOLUTION AND RESIDUES DEGRADATION OF CHERRY TOMATO (SOLANUM LYCOPERSICUM L. VAR. CERASIFORME)
5619	Yaowarat	Wongsrisakulkaew	EFFECT OF FRUIT BAGGING ON QUALITIES OF PUMMELO CV. KAO NAM PHEUNG AND KAO YAI
5620	Sasirada	Seepim	EVALUATION OF LARGE DIAMETER JET GROUTING TECHNIQUE USED FOR TUNNEL CONSTRUCTION IN BANGKOK
5621	Rokhmatuloh	Rokhmatuloh	SPATIO-TEMPORAL RICE PHENOLOGY USING UAV IN PARAKAN SALAK, SUKABUMI REGENCY, INDONESIA
5622	Supriatna	Supriatna	RICE PRODUCTIVITY ESTIMATION USING SENTINEL-2A IMAGERY IN KARAWANG REGENCY, WEST JAVA, INDONESIA

5623	Ari	Wibowo	STRUCTURAL BEHAVIOR OF NON-DUCTILE REINFORCED CONCRETE COLUMNS
5624	Santirote	Keatsirirote	EFFECT OF ELECTROLYZED OXIDIZING WATER AND ULTRASONICATION ON PATHOGENIC CONTROL OF FRESH TUMERIC (CURCUMA LONGA L.)
5625	Erica	Kotani Caram	EFFECTS OF OZONE SPARGING ON GROUNDWATER PHYSICAL-CHEMICAL PARAMETERS DURING IN SITU REMEDIATION OF A SITE CONTAMINATED WITH CHLORIDES
5628	Koharu	Ota	STATISTICAL ANALYSIS OF THE INFLUENCE OF TRAFFIC AND ENVIRONMENTAL DISTURBANCES ON DAMPING IN A BRIDGE
5629	Chanyapat	Sangsuwon	EXTRACTED OF THE ANTHOCYANINS FROM CLITORIATERNATEAFOR STAINED PROTOZOA AND ANTIAMOEBIC ACTIVITY.
5631	Ahmed	Al-Obaidi	REDUCTION IN BEARING CAPACITY OF GYPSEOUS SOILS WITH CAVITIES
5634	Dowroong	Watcharinrat	A STUDY OF THE EFFECTS OF THE FLOOD IN 2554 ON AGRICULTURAL MACHINERY USE IN RICE PADDY FIELDS IN PATHUMTHANI PROVINCE
5636	Ketsarakon	Oatyimprai	EFFECT OF TRADITIONAL THAI MASSAGE ON MUSCLE OXYGEN SATURATION IN LOW BACK PAIN PATIENTS: A PRELIMINARILY STUDY
5637	Aleksander	Purba	DESIGN AND IMPLEMENT A MONITORING SYSTEM OF TRAFFIC SIGNAL USING MICROCONTROLLER DEVICES
5640	Palida	Tanganurat	PROBIOTICS ENCAPSULATED FRUIT JUICE PEARLS AS FUNCTIONAL FOOD PRODUCT
5641	Rabee	Rustum	DAIRY WASTEWATER TREATMENT BY VERMI-BIOFILTRATION (EXPERIMENTAL STUDY)
5642	HARI NANDAN PARSAD	SINGH	EFFECT OF ENVIRONMENTAL FLUCTUATIONS ON INCIDENCE OF MYCOFLORA
5643	Dewi	Susiloningtyas	SYSTEM DYNAMIC MODELLING FOR SWORD AND WHITE POMFRET FISH RESOURCES AT DEPOK COAST, BANTUL REGENCY
5645	Naim	Asha	ENHANCING THE ROLE OF BENT-UP BARS IN SHEAR BEYOND THE CODE REQUIREMENTS BY USING PLANE-CRACK INTERCEPTOR-CROSS DIAGONAL FORM
5650	Hua Thanh	Than	EFFECT OF EXCESS PORE WATER PRESSURE IN SATURATED SANDY SOIL FOR EVALUATING LIQUEFACTION POTENTIAL DURING EARTHQUAKE DURATION
5651	AIDAN	NEWMAN	FRESH PROPERTIES PERFORMANCE OF ALKALINE ACTIVATED PALM OIL PASTE
5652	NURADILA IZZATY	HALIM	ANALYSIS OF THE PERFORMANCE AND ELEMENTAL ANALYSIS ON LIME ACTIVATOR POFA
5653	Dilip	Kumar	PREDICTION OF GROUNDWATER LEVEL USING A DISCRETE SPACE-STATE MODEL AS AN ALTERNATIVE TO PHYSICALLY BASED GROUNDWATER MODELLING
5654	Nunchanok	Nanthachai	EFFECT OF KNEADING AND FERMENTATION TIME ON CHEMICAL QUALITY OF HERBAL TEA FROM MANGO PEEL
5656	Dr. Hendrawati	Hendrawati	FORMULATION, ANTIOXIDANT AND ANTIBACTERIA ACTIVITIES OF PEEL-OFF GEL MASK, ENRICHED WITH BIDARA LEAF (ZIZIPHUS SPINA-CHRISTI L.) EXTRACT
5658	Merlita	Medallon	PHYSICAL AND CHEMICAL PROPERTIES OF WATER: CASE OF TAAL LAKE, PHILIPPINES
5659	Chomsin Sulistya	Widodo	A STUDY ON ELECTRICAL IMPEDANCE IN RIPENING AMBON-BANANAS (MUSA PARADISIACA VAR. SAPIENTUM) PROCESSES STIMULATED BY ETHREL (2-CHLOROETHYL PHOSPHONIC ACID)
5660	WALAIPORN	MAKKAPAN	DNA EXTRACTION METHODS FOR FIN OF MACKERELS IN THAILAND

5663	Prang	Subpa-asa	THE STUDY ON EFFECT OF LIGHTWEIGHT CONCRETE BLOCK BY WATER HYACINTH ADDING.
5669	Makoto	Minemoto	STUDY ON THE PROPERTIES OF CEMENT MILK ADDED WITH BAKING SODA -COMPRESSION STRENGTH ESTIMATION FROM BLEEDING REDUCTION AND INITIAL ELECTRICAL RESISTIVITY
5671	Sharifa	AlHashmi	STEADY STATE GROUNDWATER FLOW MODEL OF WADI SAMAIL CATCHMENT
5672	Rohayu	Che Omar	DURABILITY STUDY OF MALAYSIA ROCK MASS FOR TUNNELLING CONSTRUCTION
5673	Rasyikin	Roslan	APPLICATION OF WASTE WATER AND GREEN ALGAE TO STRENGTHEN SOIL
5674	Koki	Sakita	QUANTITATIVE INTERPRETATION OF LANDSLIDE OCCURRENCE SITE BY AI TECHNOLOGY OF IMAGE CLASSIFICATION AND TOPOGRAPHICAL ANALYSIS MAP CREATED BY AERIAL LASER DATA
5675	Piyawadee	Saraphirom	H2 PRODUCTION FROM LACTIC ACID RICH MEDIUM AND CASSAVA STARCH WASTEWATER BY KLEBSIELLA PNEUMONIAE SUBSP. PNEUMONIAE
5676	Mullika	Teerakun	OPTIMIZATION OF PARAQUAT DEGRADATION WITH MICROBIAL CONSORTIUM FROM CONTAMINATED SOIL USING STATISTIC METHOD
5678	Sri Yadial	Chalid	ANGIOTENSION CONVERTING ENZYME (ACE) INHIBITORY ACTIVITY OF PROTEIN EXTRACT OF MUNG BEANS (VIGNA RADIATA L.) TEMPEH FERMENTED BY RHIZOPUS SP.
5679	Hilwin	Nisa'	ESTIMATION OF PROPENSITY SCORE USING LOGISTIC REGRESSION (CASE STUDY: BREASTFEEDING DATA IN SELOPURO SUB-DISTRICT BLITAR REGENCY)
5680	Fathiyyah	-	THE MORPHOLOGY AND PHENOLOGY OF YELLOW COMMON BEAN (F7) AS OFFSPRING OF INTRODUCED AND LOCAL VARIETY CROSSING
5681	abdul	hakam	LIQUEFACTION MAPPING PROCEDURE DEVELOPMENT: DENSITY AND MEAN SIZE FORMULATIONS
5682	Febrin Anas	Ismail	COMPARISON STUDY ON DAMAGE PATTERN OF TWO STORIES BUILDING: SIMULATION VERSUS FIELD RECORD
5683	Jennie	Bautista	CRAFTING A THEORETICAL FRAMEWORK ON WASTE MANAGEMENT: A CASE FOR SUSTAINABLE CITIES
5689	A S M Fahad	Hossain	HUMAN BEHAVIOUR AND WORKPLACE SAFETYOF READY-MADE GARMENT FACTORIES IN DHAKA DURING FIRE: A CURRENT SCENARIO
5690	Wasis	Wasis	FORWARD MODELING FOR SUBSURFACE SYNTHETIC SEISMOGRAM
5693	Siti	Rochaeni	THE PERFORMANCE OF INDONESIAN AGRICULTURAL EXTENSION WORKER
5695	PATCHARAPORN	NARKTHEWAN	DETERMINATION OF HISTAMINE-FORMING BACTERIA, TOTAL COLIFORM AND ESCHERICHIA COLI IN FERMENTED FOODS
5696	Intira	Lichanporn	VITAMIN AND MINERAL CONTENT OF SIX NATIVE VARIETIES OF RICE IN THAILAND
5698	Arinto Yudi Ponco	Wardoyo	ULTRAFINE PARTICLE FILTER DESIGN FOR MOTORCYCLE EMISSION EXHAUST SYSTEM: A HIGH VOLTAGE ELECTROSTATIC-BASED SYSTEM
5700	John Lemar	Tirao	LIQUEFACTION POTENTIAL MAPPING OF THE CITY OF VALENZUELA
5702	NURUL REZUANA	BUYUNG	THE PROPERTIES OF POROUS CONCRETE PAVING BLOCKS
5703	Shengping	Zhang	CONSTRUCTING AN ARTIFICIAL INTELLIGENCE MODEL FOR WATER ENVIRONMENT EVALUATION

5705	Yasuyuki	Kubota	INFLUENCE OF ERRORS THAT RESULT FROM CONSIDERATION OF WATER IN-FLOW DIMENSION DIFFERENCES BASED ON OBSERVATION METHOD FOR MOUNTAIN TUNNEL CONSTRUCTION
5706	Nonthaphong	Phonphuak	THE USE OF SAWDUST WASTE ON PHYSICAL PROPERTIES AND THERMAL CONDUCTIVITY OF FIRED CLAY BRICK PRODUCTION
5707	Naoto	Samori	THE VERIFICATION OF DIFFERENCE ANALYSIS IN THE HIGH PRECISION INSPECTION TECHNOLOGY FOR SLOPE SURFACE, USING MOBILE MAPPING SYSTEM
5709	Zul-Atfi	Ismail	LESSON LEARNED IN MAINTAINING THE PRECAST CONCRETE BUILDINGS
5710	Porntip	Wongkaew	AFM VISUALIZATION OF PHYTOPLASMA DNA IMMOBILIZATION AND HYBRIDIZATION EVENT ON CHITOSAN MODIFIED SPCE SURFACE
5711	SHOJI	KAMAO	EXPERIMENTAL STUDY ON SOIL IMPROVEMENT OF COHESIVE SOIL FOR CONSTRUCTION FIELD
5716	Kansiri	Pakkethati	IMPROVEMENT THE PROPERTIES OF POLY(L-LACTIDE) FILMS WITH CELLULOSE FIBER FROM RICE STRAW WASTE IN AGRICULTURAL PRODUCTS
5720	Tatsuya	MATSUURA	ON THE SEASONAL COLORS AND SMELLS ANALYZING SOCIAL NETWORKING SERVICE
5721	Hideyuki	Ito	ANALYSIS OF HABITAT AREA FOR ENDANGERED SPECIES USING MAXENT BY ROAD CONSTRUCTION AND HOUSING LAND DEVELOPMENT IN CHIBA, JAPAN
5724	John Lemar	Tirao	PROPOSED ANGAT RIVER WATER IMPOUNDING AND FLOOD MITIGATION PROJECT
5726	Jennie	Bautista	SOLID WASTE GENERATION IN THE PHILIPPINES: A CORRRELATIONAL ANALYSIS ON ECONOMIC AND SOCIAL METRICS
5727	Andrian	Achmad	SUSTAINABLE AQUACULTURE MANAGEMENT OF VANAMEI SHRIMP (LIPTOPENAEUS VANNAMEI) IN BATUKARAS VILLAGE, PANGANDARAN, INDONESIA
5728	Michael	Almeida	A RISK ASSESSMENT FRAMEWORK FOR HIGH-RISE SCHOOL BUILDING PROJECT IN METRO MANILA, PHILIPPINES
5732	Thapthai	Chaithong	ASSESSMENT OF DEBRIS FLOW VELOCITY USING A SIMPLE LUMPED MASS MODEL FOR DEBRIS FLOW MOBILIZATION
5739	PADMAVATHI	M	DYNAMIC ANALYSIS OF NAILED SLOPE
5741	Padmavathi	V	SETTLEMENT OF SILTY SOIL UNDER SATURATION USING MICRO SYNTHETIC FIBERS
5742	Galih Jati	Utomo	ANALYSIS ON SPATIAL USE AND LAND USE IN NORTH JAKARTA ADMINISTRATIVE CITY
5743	Mohamed	Eltaher	GROUND IMPROVEMENT USING GEOSYNTHETICS ~ A LITERATURE REVIEW
5744	karin	kandananond	THE PATHWAY TO THE ORGANIZATION SUSTAINABILITY THROUGH THE LAND FOOTPRINT METHOD
5745	Toghrul	Karimli	STATICAL MODEL OF THE PIEZOELECTRIC SELF-ADJUSTING GYROSCOPE-ACCELEROMETER
5748	Mohammad Ashrafuzzaman	Gulandaz	DESIGN AND ASSESSMENT OF A BATTERY OPERATED ROTARY TYPE LOW COST WEEDER FOR NON-CHEMICAL UP-LAND CROP MANAGEMENT
5749	Dianna	Kosyan	EVALUATION OF THE TOXIC EFFECTS OF SMOKELESS CHEWING MIXTURES USING THE EXAMPLE OF NASWAR BASED ON BIOLUMINESCENCE TESTING METHOD
5757	Robert Michael	Tampus	PROPORTION AND PROPERTY SPECIFICATIONS AND STRENGTH BEHAVIOR OF MORTAR USING WOOD ASH AS PARTIAL REPLACEMENT OF LIME

5758	Chinnapan	Makpiboon	IMPACTS OF WEATHER VARIABLES ON URBAN WATER DEMAND AT MULTIPLE TEMPORAL SCALES
5760	Luminda	Gunawardhana	GROUNDWATER LEVEL RISE IN MUSCAT AIRPORT AREA AND WAYS OF MANAGING THE ISSUE
5762	Korntouch	Kosidphokin	PARTICIPATION IN WASTE MANAGEMENT BY UNDERGRADUATE STUDENTS OF RAJAMANGALA UNIVERSITY OF TECHNOLOGY THANYABURI.
5763	Korntouch	Kosidphokin	ENVIRONMENTAL MANAGEMENT FOR GREEN UNIVERSITY BASED ON THE UI GREEN METRIC OF UNIVERSITY SUCCEED
5764	Mahad	Baawain	INVESTIGATING OZONE LEVELS IN MUSCAT AREA, OMAN BY USING ARTIFICIAL NEURAL NETWORKS
5766	Shailesh	Jha	SUSTAINABLE SOLID WASTE MANAGEMENT (BEST PRACTICES)
5767	Hanizam	Awang	LIGHTWEIGHT FOAMED CONCRETE INTERLOCKING BLOCK UTILISING UNGROUND OIL PALM ASH
5768	Nurina	Fitriani	FINANCIAL AND INSTITUTIONAL ASPECT FOR APPLICATION OF A CENTRALIZED DOMESTIC WASTEWATER MANAGEMENT SYSTEM IN SUKOLILO DISTRICT, SURABAYA, INDONESIA
5769	Eddy Setiadi	Soedjono	STUDY ON MUSRENBANG MECHANISM IN INDONESIA TO PROMOTE SANITATION
5770	Unggul Pundjung	Juswono	THE IMPACT OF EXPOSURE TO AEROSOL MOSQUITOES REPELLENT RELATED TO FREE RADICALS ON THE ORGANS OF MALE RATS
5772	Trung	Ngo Duc	ANALYSIS OF CHANGES IN SHEAR STRENGHT AND STIFFNESS OF HO CHI MINH CITY' SOFT SOIL UNDER THE UNLOADING STRESS PATHS FOR DEEP EXCAVATIONS CALCULATION
5773	Febrin Anas	Ismail	SELF-SUPPORT SHELTER AS AN ALTERNATIVE SOLUTION IN THE TSUNAMI-PRONE AREA
5774	Karen Joyce	Santiago	GREEN CONCRETE HOLLOW BLOCKS UTILIZING BASIC OXYGEN FURNACE STEEL SLAG
5776	Deendayal	Rathod	RESPONSE OF A SINGLE PILE LOCATED ON SLOPING GROUND UNDER DYNAMIC LOADING
5777	Kumpon	Subsomboon	BIM-BASED SIMPLIFIED APPROACH TO AUTOMATICALLY ESTIMATE BUILDING COSTS FOR PROJECTS IN THAILAND
5779	Nualsawat	Hiransakolwong	EMOTIONAL QUOTIENT ASSESSMENT PROGRAM FOR STUDENTS
5780	Dalal	Maturi	THE MODIFIED DECOMPOSITION METHOD FOR SOLVING VOLTERRA FREDHOLM INTEGRO-DIFFERENTIAL EQUATIONS USING MAPLE
5781	Pawel	Sowa	ELECTROMAGNETIC SWITCHING TRANSIENTS IN TRANSMISSION LINE COOPERATING WITH THE LOCAL SUBSYSTEM
5782	Takeshi	Saito	VARIATIONS IN WATER QUALITY ALONG ACIDIC RIVERS IN VOLCANIC AREAS OF EASTERN JAPAN
5784	Nur Sabahiah Abdul	Sukor	SAFETY, CONNECTIVITY AND COMFORTABILITY AS INDICATORS TO IMPROVE WALKABILITY TO THE BUS STOPS IN PENANG ISLAND
5785	Mohd Altaf	Wali	STUDY OF ELECTRON FLUXES IN IONOSPHERE-PLASMASPHERE COUPLING FROM WHISTLERS OBSERVED AT LOW LATITUDE GROUND STATION JAMMU L= 1.17
5787	Anujit	Phumiphan	APPLICATION OF CONDITIONAL CULTURE ALGORITHM AND SIMULATION FOR OPTIMAL RESERVOIR RULE CURVES PROJECTS
5789	Svetlana	Barannikova	METAL PLASTICITY AND PERIODIC TABLE
5791	Nilupul	Gunasekara	A STUDY OF FLOOD FORECASTING AND MAPPING FOR THE ATTANAGALU OYA
5792	May Myo	Han	WATER FOOTPRINT OF RICE IN MYAUNGMYA TOWNSHIP, MYANMAR
5793	Watcharagon	Wongkamjan	LAO KHAM'S VARISCITE PROPERTIES AND APPLICATION IN CHEMICALLY BONDED PHOSPHATE CEMENT

5794	Niaz	Md. Ashraful Haque	PERFORMANCE EVALUATION OF CONCRETE WITH RECYCLED WASTE POLYPROPYLENE
5797	Yasumasa	Tojo	THE EFFECT OF INSIDE CIRCUMSTANCE OF THE HAZARDOUS WASTE LANDFILL ON THE LEACHING BEHAVIOR OF HARMFUL HEAVY METALS
5798	Samatcha	Krungkaew	COSTS AND BENEFITS OF USING PARABOLIC GREENHOUSE SOLAR DRYERS FOR DRIED HERB PRODUCTS IN THAILAND
5804	Lasmini	Ambarwati	AIR POLLUTION CONCENTRATION AND COST FOR THE DIFFERENT ROAD CORRIDORS
5805	Yuwadee	Insumran	MICROBIOLOGICAL AND CHEMICAL PROPERTIES OF THE CHI RIVER, MAHA SARAKHAM PROVICE, THAILAND
5807	Doungnapa	Promket	EFFECTS OF CLIMATES CHANGE ON MILK YIELD AND MILK COMPOSITION IN THAI CROSSBRED HOLSTEINS COWS
5809	SAAD	ALABDULLAH	LIFE CYCLE COST ANALYSIS FOR REINFORCED GEOGRID RAILWAY TRACK

DESIGN AND IMPLEMENT A MONITORING SYSTEM OF TRAFFIC SIGNAL USING MICROCONTROLLER DEVICES

*Aleksander Purba[1], Rahayu Sulistyorini[2], Agung Ilhami[3] and Ageng Sadnowo Repelianto[4]

[1,2,3,4]Faculty of Engineering, University of Lampung, Indonesia

*Corresponding Author, Received: 00 Oct. 2018,   Revised: 00 Nov. 2018, Accepted: 00 Dec. 2018

ABSTRACT: This project focused on designing traffic signal monitoring tools, based on ideas and concepts developed previously. Authors used the Arduino Nano module with ATmega328P as the microcontroller, which was chosen because it simplifies the scenario of traffic signal anomalies, short messages service (SMS) news content, and time settings. A microcontroller was used to process data from the interference detection result, and processing the SMS content, therefore, it is able to quickly inform the types of traffic signal disruptions. This research highlights the ability to autonomously diagnose traffic signal device systems, especially in its work function, with the intent to detect interference on the device, and provide report via SMS to a monitoring unit that is located under its respective division. Based on result findings it is possible to utilize this development in building an integrated traffic signal monitoring system services, in the form of mobile applications in the near future.

Keywords: Monitoring system, Traffic signal, Microcontroller, Malfunctioning, Short message service

1. INTRODUCTION

Traffic signal infrastructure is responsible for assigning the right of way to vehicular and pedestrian passage at intersections. Meanwhile, its management and operations requires the proper design, location, operation and maintenance, to provide safe and efficient movements. A lot of mysteries surround its mechanism of action, although they are relatively simple as the installation comprises of traffic signal heads, detection and a controller, which is the 'brains' behind the equipment, containing the information required to force the lights through various sequences. These signals run under a variety of modes, dependent on location and time of day, which under fixed time operation, displays green to each approach for the same amount of time per cycle, regardless of the traffic conditions.

This may be adequate in heavily congested areas, while instances where a lightly trafficked side road is included within the sequence, the system becomes very wasteful, as no vehicles are waiting in some cycles, and the time could be better allocated to the busier approach. Vehicle actuation is one of the most common modes of operation, and as the name suggests, it takes into account demands on all approaches and also adjusts the green time accordingly. Furthermore, the requirements to actualize this mechanism are registered through the detection installed, either in the carriageway or above the signal heads, which the controller processes and further allocates the green time in the most appropriate way.

However, minimum and maximum periods are specified, and this cannot be violated, therefore, a vehicle passing a detector demands a certain phase and once that phase is green, any subsequently passing automobile, causes the phase to extend. This continues as such up to the point where either the traffic demand ceases and another approach gains green, or a conflicting demand causes the maximum timer to count down. Moreover, while vehicle actuation mode is more responsive than fixed time it also has the propensity of being inefficient in instances where long queues build up on conflicting approaches. The setting of maximum timers is then difficult due to changes in traffic patterns through junctions over time, which should therefore be regularly updated, in order to maintain effective operation. This is a labor intensive task for a local transportation authority, which is often not undertaken, thus leading to the signals becoming less effective over time.

As all electronic equipment, these devices are subject to breakdowns, malfunctions, and power outages, which could lead to safe intersections becoming dangerously congested and confusing, therefore resulting in needless accidents. However, a study on the city of Boston calculated that simply reconfiguring the timings of 60 intersections in one district of the city could save US$1.2 million per year, in terms of person-hours, safety, emissions, and energy costs [1]. In situations where malfunctioning occurs, the entity responsible for maintaining the signal may be held accountable, as regions and municipalities have a statutorily imposed duty, which ensure roads are safe for users. Furthermore, the Province of Ontario has set up certain minimum requirements for the maintenance

of roadways, which include standards related to traffic signals, according to Regulation 239/02, which states the Minimum Maintenance Standards for Municipal Highways, under the Municipal Act. However, section 13 of the O.Reg 239/02 stipulates that in cases where a malfunctioning traffic control signal system occurs, the minimum guideline is to "deploy resources as soon as practicable after the awareness of the defect, in order to commence repairs or replacements" [2]. Meanwhile, most regions and municipalities have no statutory in this regards as Ontario, and due to the fact that most of the traffic signals are categorized as isolated intersections, the surveillance system is therefore highly dependent on road users report. Hence, response time needed is longer, especially during out of work hours.

This project focused on designing traffic signal monitoring tools, based on ideas and concepts developed from the research conducted by Sivarao, Subramanian, Ezro and Anand [3] and Marzuki, Ahmad, Buyamin, Abas and Said [4], as well as self-diagnosis techniques, using the Reed-Solomon Codes by Tang and Wang [5]. Furthermore, a monitoring system with Proteus advancement tool, developed in Africa, was also used [6]. However, activities including designing concepts, materials selection, assembling tools, and traffic signal Fig.1

2. RESEARCH METHODOLOGY

The product was designed based on electronic circuit plan, where all blocks were arranged on the project board and tested individually, and also a combination on printed circuit board (PCB) was conducted, at periods of proper function. This study used the Arduino Nano module with ATmega328P as the microcontroller, which was chosen because it simplifies the scenario of traffic signal anomalies, short messages service (SMS) news content, and time settings.

This also facilitates programming, possesses a memory capacity that is capable of accommodating program scripts, it is affordable, readily available, and is relatively small in size. However, programming was carried out using the built-in Arduino IDE open-source software, and the general description of electronic circuit design is seen in Fig. 1 as developed previously [7-9].
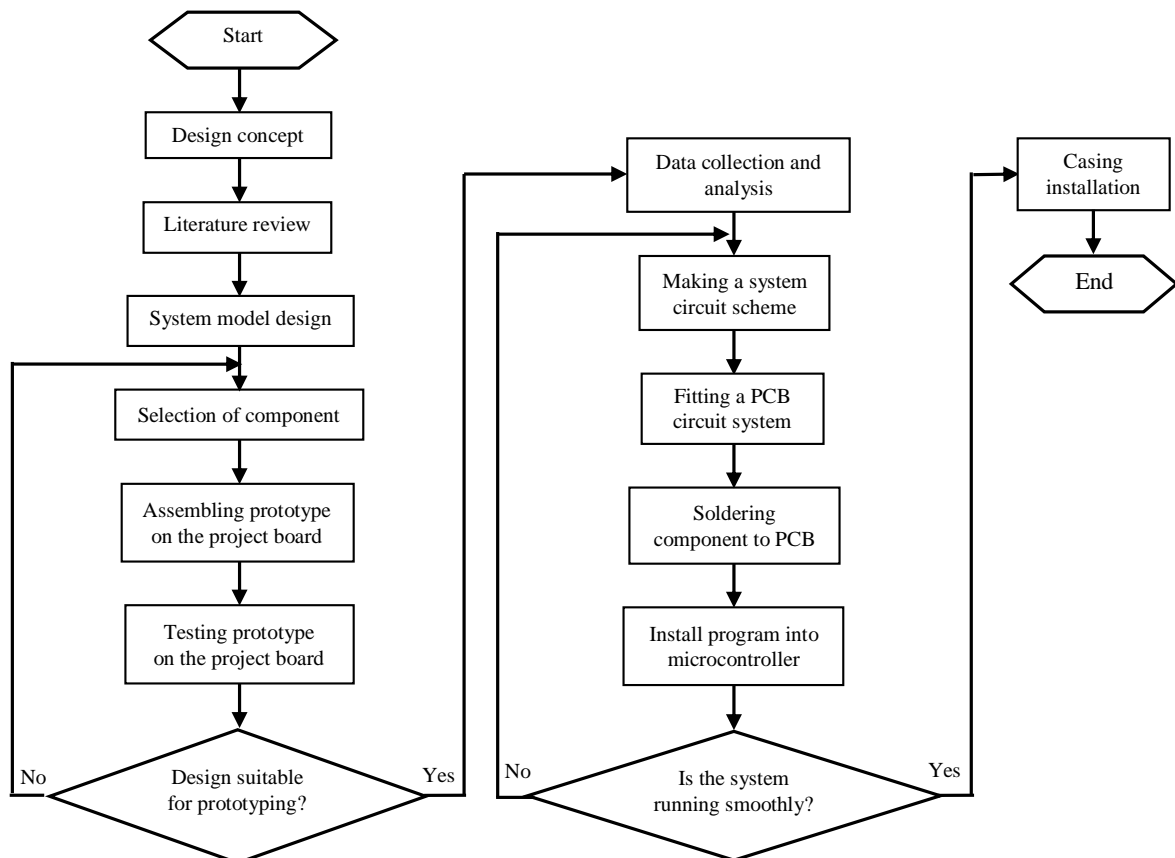

Fig. 1 Design circuit flow chart

3. RESULT AND DISCUSSION

Each traffic signal display is equipped with a form of light sensor, positioned in a way, in order to detect beams from the traffic signal. This is then processed by the logic gate and microcontroller to be diagnosed, based on the rational state, guard time and verification of the programming anomaly scenario. Furthermore, the microcontroller recognizes the anomaly and immediately turns all traffic signal display (red, yellow and green) off. Meanwhile, during the termination process, the microcontroller instructs the A6 GSM module to dispatch an SMS, at certain time intervals, according to the program (e.g., once every hour) as developed previously in context of documents identification in a library system [10]. Therefore, the emergency light flashes periodically, serving as a visual marker, which indicates that the signal is under repair. Hence, mobile or smartphones can be used as an SMS receiver by entering the recipient's number from the traffic signal in the microcontroller program.

Switching mode power supply (SMPS) with DC 12V 10A voltage was used as the main source. This voltage was chosen to supply the relay and a series of LED lights on the traffic display and emergency flash. In addition, step-down DC to DC buck converter was also applied by reducing the DC 12 Volt voltage from SMPS to DC 5V 3A, which was further used to supply logical state, guard time, data latch, reflected light sensor, GSM A6 module, and the microcontroller as shown in Fig. 2.

Fig. 2 Devices diagram block

Referring to Fig. 2, a design of electronic series consists of some blocks:

1.   The traffic signal display block consists of the combination of a series of light emitted diode (LED) illuminations (red, amber and green), and placed between them are three light dependent resistor sensors (LDRs), used to detect reflections produced by LEDs and other reflectors.

2.   The emergency flash display block consists of a combination of LED beams, functioning as visual markers, and the main traffic signal, during the repair process.

3.   Reflection sensor block. The readings of each LDR (red, amber, and green) are entered into three voltage comparator circuits. Therefore, if it obtains reflected light, the sensor produces a LOW logic, and on the contrary, a HIGH logic is emitted in the absence of reflected light.

4.   The logical state block is an electronic

path, which uses an integrated circuit (IC) type CD4028 (BCD to decimal decoder), designed to identify different bits of each sequence of statement traffic signals, in cases of anomaly. Furthermore, the input pin of this IC is a 4-bit binary number (from 0000 to 1111), while the output pin is represented by 10 digits (Y0 to Y9). The following are some identity bits designed for each traffic signal anomaly statement:

4.1. the red display is given the 0101-bit, characterized by pin Y5.

4.2. the amber demonstration specifies the 0011-bit, represented by pin Y3.

4.3. the green exhibition is allotted the 0111-bit, denoted by pin Y7.

5. Guard time block: Anomalous data Y5, Y3, and Y7 cannot be considered valid when in the guard time series, which was allotted a time period of 1 second in this study. For example, if Y5 sends an under-1 second-anomalous signal, it is not considered an anomaly and vice versa.

6. Latch data block: After the validity of the anomaly signal has been considered, the block is then locked (latch). This is further processed by the microcontroller, at the end of a cycle of traffic signal.

7. Microcontroller block: This is divided into five sub-blocks with their respective functions, including:

7.1. timing traffic signal functions as a time allocator per cycle.

7.2. Provision of additional bit function for CD4028 IC input (logical statement block), in determining bit during an anomaly.

7.3. Anomaly data verification scenario, through the process of matching results of processing data latch blocks with anomalous scenarios, which have been programmed in the microcontroller.

7.4. SMS sending command, when a change in the traffic signal anomaly was considered a malfunction (through the verification process) to be forwarded as news to the A6 GSM module block.

7.5. emergency flash: This sub-block works by flashing, depicting a sign that the main traffic signal is under maintenance.

8. The GSM block A6 module works by sending SMS on the processing results, from the microcontroller to the operator. This occurs because the unit has been recognized by the Arduino library, therefore, it is easily programmed in the IDE, with the AT command instruction set.

9. Relay block is a series, consisting of 4 types of transmissions, while the ULN2803A IC and opto-coupler turns ON or OFF the traffic signal display and emergency flash. These conditions for the four types of relay, follow the order of the microcontroller sub-block timing functions.

The traffic signal cycle in this study followed the sequence as shown in Fig 3.

1. Red OFF, Amber ON, Green OFF;
2. Red ON, Amber OFF, Green OFF;
3. Red ON, Amber ON, Green OFF;
4. Red OFF, Amber OFF, Green ON;
5. The second cycle (restarts from Red OFF, Amber ON and Green OFF).
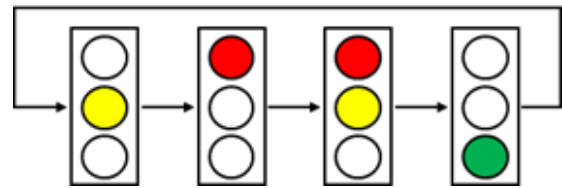

Fig. 3 Traffic signal cycle

Hence, the implementation of a monitoring system completely as combined work of Fig. 1 and Fig. 2 respectively, shown in the Fig. 4 below.
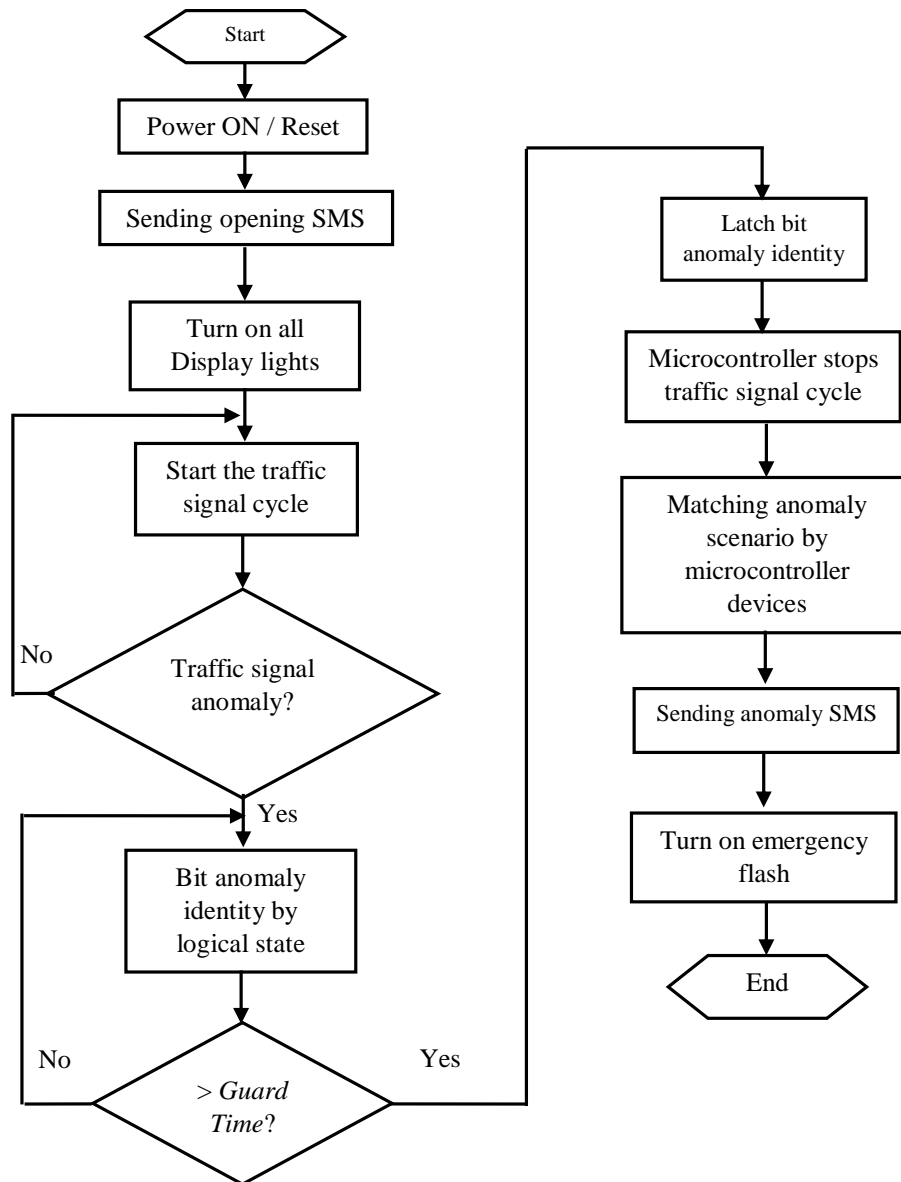
4

```
                    ┌─────────┐
                    │  Start  │
                    └────┬────┘
                         │
              ┌──────────▼──────────┐
              │  Power ON / Reset   │
              └──────────┬──────────┘
                         │
              ┌──────────▼──────────┐
              │ Sending opening SMS │
              └──────────┬──────────┘
                         │
              ┌──────────▼──────────┐
              │     Turn on all     │
              │   Display lights    │
              └──────────┬──────────┘
                         │
              ┌──────────▼──────────┐
              │  Start the traffic  │
              │    signal cycle     │
              └──────────┬──────────┘
                         │
                   ╱─────▼─────╲
            No   ╱  Traffic      ╲
           ◄────  signal          
                ╲  anomaly?      ╱
                   ╲─────┬─────╱
                         │ Yes
              ┌──────────▼──────────┐
              │    Bit anomaly      │
              │    identity by      │
              │   logical state     │
              └──────────┬──────────┘
                         │
            No     ╱─────▼─────╲     Yes
           ◄──────  > Guard     ──────►
                   ╲  Time?     ╱
                   ╲───────────╱
```

Fig. 4 Flow chart of signal monitoring system

4. CONCLUSION

This research highlights the ability to autonomously diagnose traffic signal device systems, especially in its work function, with the intent to detect interference on the device, and provide report via short message service (SMS) to a monitoring unit. Furthermore, this can be placed in any area covered by the Global System for Mobile Communication (GSM) wireless communication service. Meanwhile, a microcontroller was used to process data from the interference detection result, and processing the SMS content, therefore, it is able to quickly inform the types of traffic signal disruptions. Hence, it is possible to utilize this development in building an integrated traffic signal monitoring system services, in the form of mobile applications.

5. ACKNOWLEDGMENTS

6. REFERENCES

[1] Boston Transportation Department. The benefits of retiming/rephasing traffic signals in the Back Bay, 2010.

[2] http://www.cityofboston.gov/images_docume nts/The%20Benefits%20of%20Traffic%20Sig nal%20Retiming%20Report_tcm3-18554.pdf

[3] Sivarao, S. K. Subramanian, M. Ezro and T. J. S. Anand, Electrical & Mechanical Fault Alert Traffic Signal System Using Wireless Technology, International J. of Mechanical & Mechatronics Engineering IJMME-IJENS, Vol.10, No.4, 2010, pp.15-18.

[4] M. Z. A. Marzuki, A. Ahmad, S. Buyamin, K. H. Abas and S. Hj. M. Said, Fault Monitoring System for Traffic signal, J. of Teknologi (Science and Engineering), Vol.73, No.6, 2015, pp. 59-64.

[5] X. Tang and S. Wang, A Low Hardware Overhead Self-Diagnosis Technique Using Reed-Solomon Codes for Self-Repairing Chips, J. of IEEE Transactions on Computers, Vol.59, Issue 10, 2010, pp. 1309-1319.

[6] P. I. Okwu, E. S. Mbonu, C. G. Ezekwe and C. U. Ajuzie, Quick Prototyping of Real Time Monitoring System Using Proteus Development Tool: A Case for Self Diagnostic Traffic Signal System, African J. of Computing & ICT, Vol.6, No.5, 2013, pp. 147-154.

[7] P. Aleksander, S. Rahayu, S. R. Ageng and I. Agung, Developing Monitoring System of Traffic Signal Using Microcontroller Device by SMS of GSM Network, Conference Proceeding, in Proc. 1st of Nat. Conf. on SINTA FT UNILA, 2018, pp. 273-277.

[8] F. K. Rasha, Traffic Light Control System Using Microcontroller, AL-Qadisiyah J. of Pure Science, Vol.23, No.2, 2018, pp. 269-280.

[9] T. A. Kareem and M. K. Jabbar, Design and Implementation Smart Traffic Light Using GSM and IR, Iraqi Journal for Computers and Informatics, Vol.44, No.2, 2018, pp. 1-5.

[10] R. Santha Kumar, Dr. K. Kaliyaperumal. Applications of GSM Technology for Documents Identification In A Library System, International J. of Academic Library and Information Science, Vol. 2 No.1, 2014, pp. 1-6.

DESIGN AND IMPLEMENT A MONITORING SYSTEM OF TRAFFIC SIGNAL USING MICROCONTROLLER DEVICES

*Aleksander Purba[1], Rahayu Sulistyorini[2], Agung Ilhami[3] and Ageng Sadnowo Repelianto[4]

[1,2,3,4]Faculty of Engineering, University of Lampung, Indonesia

ABSTRACT: This project focused on designing traffic signal monitoring tools, based on ideas and concepts developed previously. Authors used the Arduino Nano module with ATmega328P as the microcontroller, which was chosen because it simplifies the scenario of traffic signal anomalies, short messages service (SMS) news content, and time settings. A microcontroller was used to process data from the interference detection result, and processing the SMS content, therefore, it is able to quickly inform the types of traffic signal disruptions. This research highlights the ability to autonomously diagnose traffic signal device systems, especially in its work function, with the intent to detect interference on the device, and provide report via SMS to a monitoring unit that is located under its respective division. Based on result findings it is possible to utilize this development in building an integrated traffic signal monitoring system services, in the form of mobile applications in the near future.

Keywords: Monitoring system, Traffic signal, Microcontroller, Malfunctioning, Short message service

1. INTRODUCTION

Traffic signal infrastructure is responsible for assigning the right of way to vehicular and pedestrian passage at intersections. Meanwhile, its management and operations requires the proper design, location, operation and maintenance, to provide safe and efficient movements. A lot of mysteries surround its mechanism of action, although they are relatively simple as the installation comprises of traffic signal heads, detection and a controller, which is the 'brains' behind the equipment, containing the information required to force the lights through various sequences. These signals run under a variety of modes, dependent on location and time of day, which under fixed time operation, displays green to each approach for the same amount of time per cycle, regardless of the traffic conditions.

This may be adequate in heavily congested areas, while instances where a lightly trafficked side road is included within the sequence, the system becomes very wasteful, as no vehicles are waiting in some cycles, and the time could be better allocated to the busier approach. Vehicle actuation is one of the most common modes of operation, and as the name suggests, it takes into account demands on all approaches and also adjusts the green time accordingly. Furthermore, the requirements to actualize this mechanism are registered through the detection installed, either in the carriageway or above the signal heads, which the controller processes and further allocates the green time in the most appropriate way.

However, minimum and maximum periods are specified, and this cannot be violated, therefore, a vehicle passing a detector demands a certain phase and once that phase is green, any subsequently passing automobile, causes the phase to extend. This continues as such up to the point where either the traffic demand ceases and another approach gains green, or a conflicting demand causes the maximum timer to count down. Moreover, while vehicle actuation mode is more responsive than fixed time it also has the propensity of being inefficient in instances where long queues build up on conflicting approaches. The setting of maximum timers is then difficult due to changes in traffic patterns through junctions over time, which should therefore be regularly updated, in order to maintain effective operation. This is a labor intensive task for a local transportation authority, which is often not undertaken, thus leading to the signals becoming less effective over time.

As all electronic equipment, these devices are subject to breakdowns, malfunctions, and power outages, which could lead to safe intersections becoming dangerously congested and confusing, therefore resulting in needless accidents. However, a study on the city of Boston calculated that simply reconfiguring the timings of 60 intersections in one district of the city could save US$1.2 million per year, in terms of person-hours, safety, emissions, and energy costs [1]. In situations where malfunctioning occurs, the entity responsible for maintaining the signal may be held accountable, as regions and municipalities have a statutorily imposed duty, which ensure roads are safe for users. Furthermore, the Province of Ontario has set up certain minimum requirements for the maintenance

of roadways, which include standards related to traffic signals, according to Regulation 239/02, which states the Minimum Maintenance Standards for Municipal Highways, under the Municipal Act. However, section 13 of the O.Reg 239/02 stipulates that in cases where a malfunctioning traffic control signal system occurs, the minimum guideline is to "deploy resources as soon as practicable after the awareness of the defect, in order to commence repairs or replacements" [2]. Meanwhile, most regions and municipalities have no statutory in this regards as Ontario, and due to the fact that most of the traffic signals are categorized as isolated intersections, the surveillance system is therefore highly dependent on road users report. Hence, response time needed is longer, especially during out of work hours.

This project focused on designing traffic signal monitoring tools, based on ideas and concepts developed from the research conducted by Sivarao, Subramanian, Ezro and Anand [3] and Marzuki, Ahmad, Buyamin, Abas and Said [4], as well as self-diagnosis techniques, using the Reed-Solomon Codes by Tang and Wang [5]. Furthermore, a monitoring system with Proteus advancement tool, developed in Africa, was also used [6]. However, activities including designing concepts, materials selection, assembling tools, and traffic signal Fig.1

2. RESEARCH METHODOLOGY

The product was designed based on electronic circuit plan, where all blocks were arranged on the project board and tested individually, and also a combination on printed circuit board (PCB) was conducted, at periods of proper function. This study used the Arduino Nano module with ATmega328P as the microcontroller, which was chosen because it simplifies the scenario of traffic signal anomalies, short messages service (SMS) news content, and time settings.

This also facilitates programming, possesses a memory capacity that is capable of accommodating program scripts, it is affordable, readily available, and is relatively small in size. However, programming was carried out using the built-in Arduino IDE open-source software, and the general description of electronic circuit design is seen in Fig. 1 as developed previously [7-9].

The specifications of the designed system are (1) Block system on the transmitter using voltage DC 5V; (2) Uses three types of push button as a simulator to represent three colors of traffic lights; (3) ATMega 8 microcontroller serves as the main controller of the transmitter and performs the role to analyze the push button condition; (4) Using two
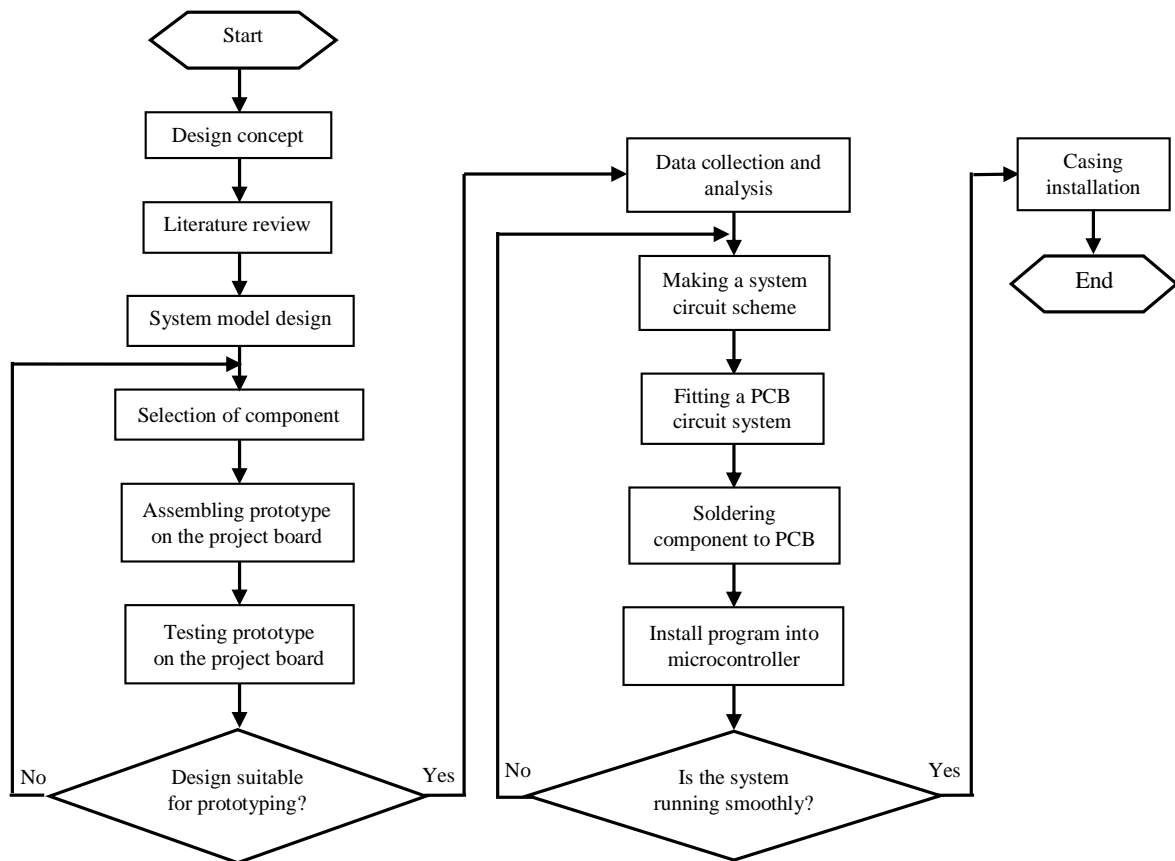

Fig. 1 Design circuit flow chart

units of mobile phone, one as a transmitter and another as a receiver; (5) The system is able to change the signal received by microcontroller into SMS to be used as information code to be displayed on personal computer (Intel Pentium PC 1.80 GHz, 256 MByte RAM, Window XP, and 80 GB HDD); (6) The data display on the computer provides information such as types of malfunction, time of incident, and traffic light location; (7) Communication between mobile phone receivers with PC is designed using serial 8 bit 19200 bps; (8) The system uses Visual Basic 6.0 to display the results of the information it receives; and (9) The system uses Microsoft Office Access 2003 to create databases.

3. RESULT AND DISCUSSION

Each traffic signal display is equipped with a form of light sensor, positioned in a way, in order to detect beams from the traffic signal. This is then processed by the logic gate and microcontroller to be diagnosed, based on the rational state, guard time and verification of the programming anomaly scenario. Furthermore, the microcontroller recognizes the anomaly and immediately turns all

traffic signal display (red, yellow and green) off. Meanwhile, during the termination process, the microcontroller instructs the A6 GSM module to dispatch an SMS, at certain time intervals, according to the program (e.g., once every hour) as developed previously in context of documents identification in a library system [10].

Therefore, the emergency light flashes periodically, serving as a visual marker, which indicates that the signal is under repair. Hence, mobile or smartphones can be used as an SMS receiver by entering the recipient's number from the traffic signal in the microcontroller program.

Switching mode power supply (SMPS) with DC 12V 10A voltage was used as the main source. This voltage was chosen to supply the relay and a series of LED lights on the traffic display and emergency flash. In addition, step-down DC to DC buck converter was also applied by reducing the DC 12 Volt voltage from SMPS to DC 5V 3A, which was further used to supply logical state, guard time, data latch, reflected light sensor, GSM A6 module, and the microcontroller as shown in Fig. 2.
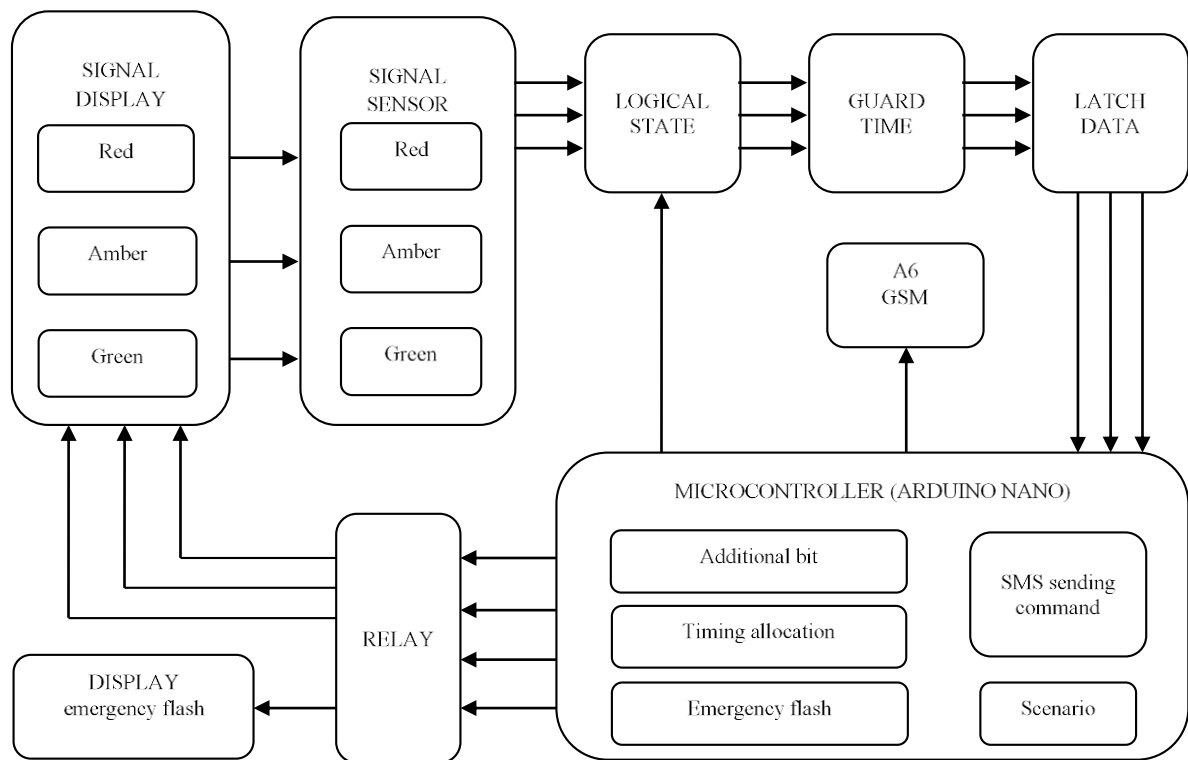

Fig. 2 Devices diagram block

Referring to Fig. 2, a design of electronic series

consists of some blocks:
1. The traffic signal display block consists of the

combination of a series of light emitted diode (LED) illuminations (red, amber and green), and placed between them are three light dependent resistor sensors (LDRs), used to detect reflections produced by LEDs and other reflectors.

2. The emergency flash display block consists of a combination of LED beams, functioning as visual markers, and the main traffic signal, during the repair process.

3. Reflection sensor block. The readings of each LDR (red, amber, and green) are entered into three voltage comparator circuits. Therefore, if it obtains reflected light, the sensor produces a LOW logic, and on the contrary, a HIGH logic is emitted in the absence of reflected light.

4. The logical state block is an electronic path, which uses an integrated circuit (IC) type CD4028 (BCD to decimal decoder), designed to identify different bits of each sequence of statement traffic signals, in cases of anomaly. Furthermore, the input pin of this IC is a 4-bit binary number (from 0000 to 1111), while the output pin is represented by 10 digits (Y0 to Y9). The following are some identity bits designed for each traffic signal anomaly statement:

4.1. the red display is given the 0101-bit, characterized by pin Y5.

4.2. the amber demonstration specifies the 0011-bit, represented by pin Y3.

4.3. the green exhibition is allotted the 0111-bit, denoted by pin Y7.

5. Guard time block: Anomalous data Y5, Y3, and Y7 cannot be considered valid when in the guard time series, which was allotted a time period of 1 second in this study. For example, if Y5 sends an under-1 second-anomalous signal, it is not considered an anomaly and vice versa.

6. Latch data block: After the validity of the anomaly signal has been considered, the block is then locked (latch). This is further processed by the microcontroller, at the end of a cycle of traffic signal.

7. Microcontroller block: This is divided into five sub-blocks with their respective functions, including:

7.1. timing traffic signal functions as a time allocator per cycle.

7.2. provision of additional bit function for CD4028

IC input (logical statement block), in determining bit during an anomaly.

7.3. anomaly data verification scenario, through the process of matching results of processing data latch blocks with anomalous scenarios, which have been programmed in the microcontroller.

7.4. SMS sending command, when a change in the traffic signal anomaly was considered a malfunction (through the verification process) to be forwarded as news to the A6 GSM module block.

7.5. emergency flash: This sub-block works by flashing, depicting a sign that the main traffic signal is under maintenance.

8. The GSM block A6 module works by sending SMS on the processing results, from the microcontroller to the operator. This occurs because the unit has been recognized by the Arduino library, therefore, it is easily programmed in the IDE, with the AT command instruction set.

9. Relay block is a series, consisting of 4 types of transmissions, while the ULN2803A IC and opto-coupler turns ON or OFF the traffic signal display and emergency flash. These conditions for the four types of relay, follow the order of the microcontroller sub-block timing functions.

The traffic signal cycle in this study followed the sequence as shown in Fig 3.

1. Red OFF, Amber ON, Green OFF;
2. Red ON, Amber OFF, Green OFF;
3. Red ON, Amber ON, Green OFF;
4. Red OFF, Amber OFF, Green ON;
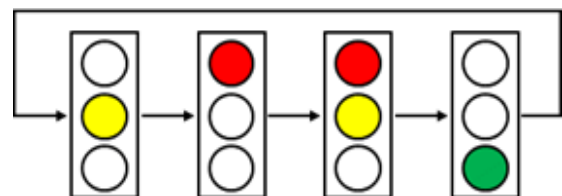5. The second cycle (restarts from Red OFF, Amber ON and Green OFF).

Fig. 3 Traffic signal cycle

Therefore, the implementation of a monitoring system completely as combined work of Fig. 1 and Fig. 2 respectively, is shown in Fig. 4 below.
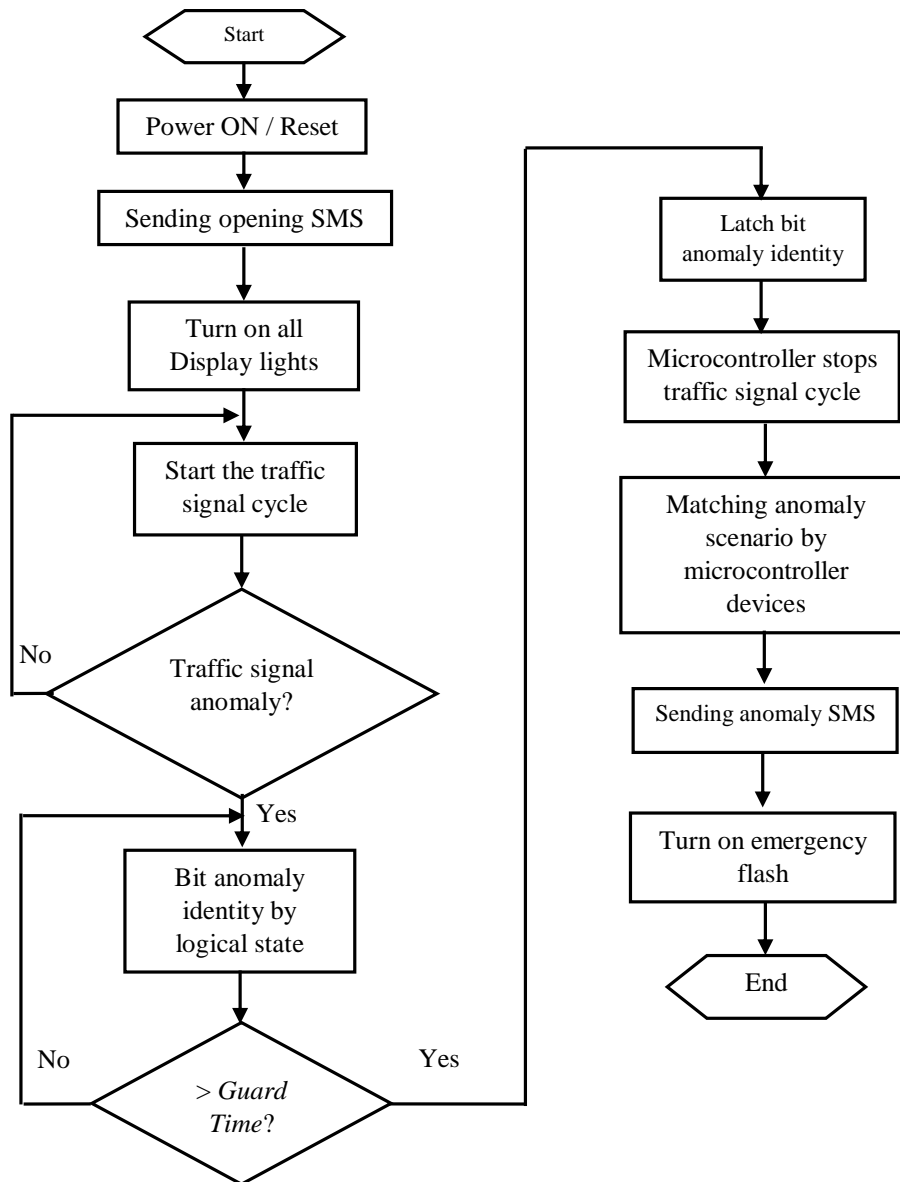
Fig. 4 Flow chart of signal monitoring system

Generally, this system has two main parts. The first part is a station which could be a simulator, a microcontroller (Arduino UNO) or a GSM SIM800L module. It functions as an information provider. While the second part is called a server, which comprises a cell phone or smartphone and a set of computers. This section performs the role of information reception. The traffic monitoring system device is basically designed to quickly inform the traffic light conditions in the event of damage. To speed up information arrival, a wireless communication service is chosen, by using a GSM SIM800L module. The microcontroller will diagnose the traffic lights conditions that are in operation. Some damages have the tendencies of occurrence when the traffic lights operate. Hence they will be programmed on this microcontroller. If there is a corresponding damage scenario, the microcontroller will order the GSM SIM800L module to send information in the form of an SMS about the damage that occurred to the server.

In the early stages of tool design, it is not yet possible to make the equipment ready for use as a whole. This is due to the need to perform simulations in advance and test tools to find the specifications to be achieved. The desired initial stage of achievement in the prototype of the self-diagnosis system of traffic lights is described as follows:
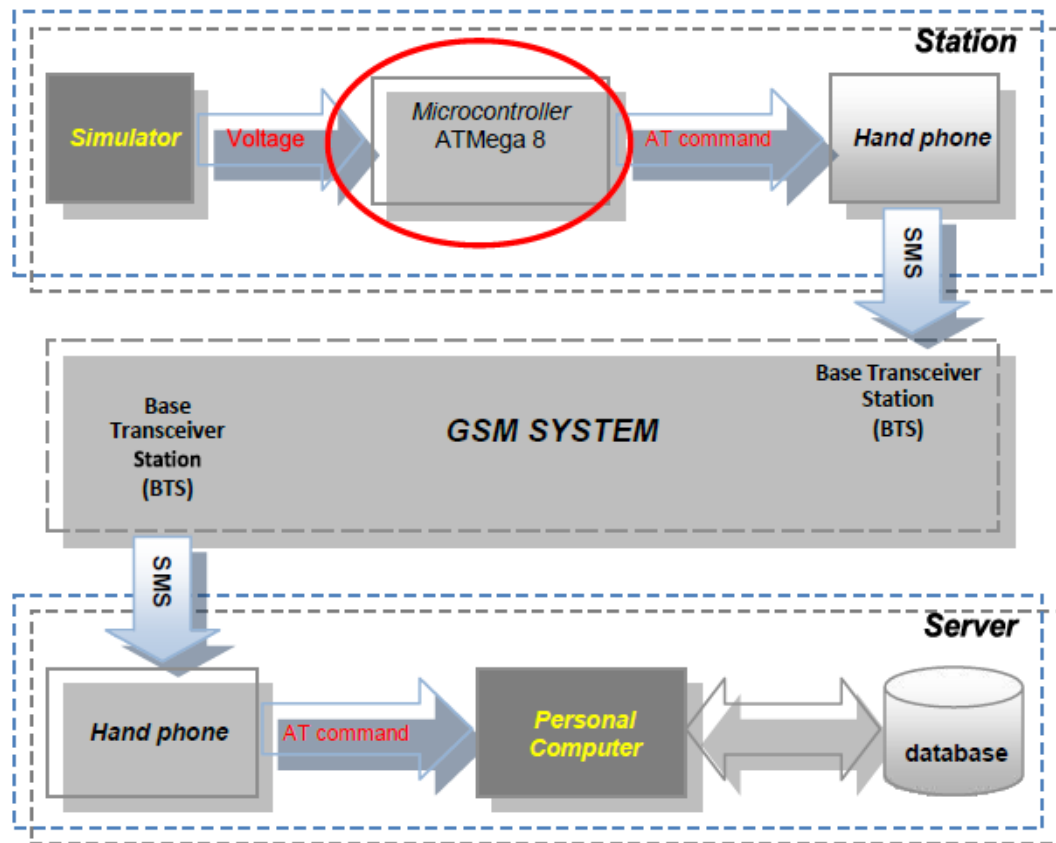
Fig. 5 Self-diagnosis system of traffic light [7]

1. The station section can provide information on its own condition (auto-update) as long as the traffic lights operate normally at a specified time to the server. for example, every 10 minutes the station continuously sends an SMS to the server that the traffic lights are operating normally.

2. The station section can provide information in the form of SMS news immediately to the section in the server in cases of malfunctions in the condition of the traffic lights that are in operation. At this initial stage, an abnormality scenario will be performed with the aid of the simulator section.

The principle behind of this simulator system is designed to replace the functions of real traffic lights. The reason for replacing the overall traffic light with a simulator is to simplify the overall system testing process. The role of the simulator is to prevent a variety of possible damage that may occur at any traffic lights on the highway. At the initial stages of this design, there are two possible abnormalities that can occur at any traffic light.

1. Abnormalities as a result of the break-up of one or more lights, also the occurrence of more than one light at the same time. The state of the light is illustrated by the high logic condition (1), while the condition of the off lights is represented by the low logic condition (0).

2. Abnormalities that occur in the timer system at the traffic light. For example, the red light is simulated for 10 seconds, after which a yellow light is followed for 5 seconds and the green light lasts for 15 seconds. This kind of scenario will be programmed inside the microcontroller. If the traffic lights operation is not in accordance with this scenario, the microcontroller will regard it as an abnormality. Furthermore, the microcontroller will instruct the SIM800L module to send SMS messages to the server that there has been an abnormality in the traffic light timer system.

The simulator section is made up of various parts, namely:

1. Four channel solid state relay (SSR) modules.

2. Arduino UNO, a microcontroller which serves as a diagnostic data processor. It is a storage place for several scenario rules and at the same time giving orders whether or not the GSM module sends news.

3. SIM800L GSM module performs the roles of sending news in the form of SMS results from diagnosis and microcontroller commands to the server. The communication service used is GSM. In this module, you must insert a SIM card that has been topped up and activated the SMS service. This SIM800L module is ordered using AT Command. Library AT Command can be easily downloaded from the official Arduino site. It is an open source,

hence anybody can download it freely and may be used for the development of a programming electronics based on Arduino.

4. The 3-color lamp module, as a miniature of the real traffic lights

5. Switching mode power supply (SMPS), as a 12-volt DC power source and 5 volts to turn on the four previous modules.

4. CONCLUSION

This research highlights the ability to autonomously diagnose traffic signal device systems, especially in its work function, with the intent to detect interference on the device, and provide report via short message service (SMS) to a monitoring unit. Furthermore, this can be placed in any area covered by the Global System for Mobile Communication (GSM) wireless communication service. Meanwhile, a microcontroller was used to process data from the interference detection result, and processing the SMS content, therefore, it is able to quickly inform the types of traffic signal disruptions. Hence, it is possible to utilize this development in building an integrated traffic signal monitoring system services, in the form of mobile applications.

5. ACKNOWLEDGMENTS

6. REFERENCES

[1] Boston Transportation Department. The benefits of retiming/rephasing traffic signals in the Back Bay, 2010.

[2] http://www.cityofboston.gov/images_documents/The%20Benefits%20of%20Traffic%20Signal%20Retiming%20Report_tcm3-18554.pdf

[3] Sivarao, S. K. Subramanian, M. Ezro and T. J. S. Anand, Electrical & Mechanical Fault Alert Traffic Signal System Using Wireless Technology, International J. of Mechanical & Mechatronics Engineering IJMME-IJENS, Vol.10, No.4, 2010, pp.15-18.

[4] M. Z. A. Marzuki, A. Ahmad, S. Buyamin, K. H. Abas and S. Hj. M. Said, Fault Monitoring System for Traffic signal, J. of Teknologi (Science and Engineering), Vol.73, No.6, 2015, pp. 59-64.

[5] X. Tang and S. Wang, A Low Hardware Overhead Self-Diagnosis Technique Using Reed-Solomon Codes for Self-Repairing Chips, J. of IEEE Transactions on Computers, Vol.59, Issue 10, 2010, pp. 1309-1319.

[6] P. I. Okwu, E. S. Mbonu, C. G. Ezekwe and C. U. Ajuzie, Quick Prototyping of Real Time Monitoring System Using Proteus Development Tool: A Case for Self Diagnostic Traffic Signal System, African J. of Computing & ICT, Vol.6, No.5, 2013, pp. 147-154.

[7] P. Aleksander, S. Rahayu, S. R. Ageng and I. Agung, Developing Monitoring System of Traffic Signal Using Microcontroller Device by SMS of GSM Network, Conference Proceeding, in Proc. 1st of Nat. Conf. on SINTA FT UNILA, 2018, pp. 273-277.

[8] F. K. Rasha, Traffic Light Control System Using Microcontroller, AL-Qadisiyah J. of Pure Science, Vol.23, No.2, 2018, pp. 269-280.

[9] T. A. Kareem and M. K. Jabbar, Design and Implementation Smart Traffic Light Using GSM and IR, Iraqi Journal for Computers and Informatics, Vol.44, No.2, 2018, pp. 1-5.

[10] R. Santha Kumar, Dr. K. Kaliyaperumal. Applications of GSM Technology for Documents Identification In A Library System, International J. of Academic Library and Information Science, Vol. 2 No.1, 2014, pp. 1-6.

DESIGN AND IMPLEMENT A MONITORING SYSTEM OF TRAFFIC SIGNAL USING MICROCONTROLLER DEVICES

*Aleksander Purba[1], Rahayu Sulistyorini[2], Agung Ilhami[3] and Ageng Sadnowo Repelianto[4]

[1,2,3,4]Faculty of Engineering, University of Lampung, Indonesia

*Corresponding Author, Received: 00 Oct. 2018,   Revised: 00 Nov. 2018, Accepted: 00 Dec. 2018

ABSTRACT: This project focused on designing traffic signal monitoring tools, based on ideas and concepts developed previously. Authors used the Arduino Nano module with ATmega328P as the microcontroller, which was chosen because it simplifies the scenario of traffic signal anomalies, short messages service (SMS) news content, and time settings. A microcontroller was used to process data from the interference detection result, and processing the SMS content, therefore, it is able to quickly inform the types of traffic signal disruptions. This research highlights the ability to autonomously diagnose traffic signal device systems, especially in its work function, with the intent to detect interference on the device, and provide report via SMS to a monitoring unit that is located under its respective division. Based on result findings it is possible to utilize this development in building an integrated traffic signal monitoring system services, in the form of mobile applications in the near future.

Keywords: Monitoring system, Traffic signal, Microcontroller, Malfunctioning, Short message service

1. INTRODUCTION

Traffic signal infrastructure is responsible for assigning the right of way to vehicular and pedestrian passage at intersections. Meanwhile, its management and operations requires the proper design, location, operation and maintenance, to provide safe and efficient movements. A lot of mysteries surround its mechanism of action, although they are relatively simple as the installation comprises of traffic signal heads, detection and a controller, which is the 'brains' behind the equipment, containing the information required to force the lights through various sequences. These signals run under a variety of modes, dependent on location and time of day, which under fixed time operation, displays green to each approach for the same amount of time per cycle, regardless of the traffic conditions.

This may be adequate in heavily congested areas, while instances where a lightly trafficked side road is included within the sequence, the system becomes very wasteful, as no vehicles are waiting in some cycles, and the time could be better allocated to the busier approach. Vehicle actuation is one of the most common modes of operation, and as the name suggests, it takes into account demands on all approaches and also adjusts the green time accordingly. Furthermore, the requirements to actualize this mechanism are registered through the detection installed, either in the carriageway or above the signal heads, which the controller processes and further allocates the green time in the most appropriate way.

However, minimum and maximum periods are specified, and this cannot be violated, therefore, a vehicle passing a detector demands a certain phase and once that phase is green, any subsequently passing automobile, causes the phase to extend. This continues as such up to the point where either the traffic demand ceases and another approach gains green, or a conflicting demand causes the maximum timer to count down. Moreover, while vehicle actuation mode is more responsive than fixed time it also has the propensity of being inefficient in instances where long queues build up on conflicting approaches. The setting of maximum timers is then difficult due to changes in traffic patterns through junctions over time, which should therefore be regularly updated, in order to maintain effective operation. This is a labor intensive task for a local transportation authority, which is often not undertaken, thus leading to the signals becoming less effective over time.

As all electronic equipment, these devices are subject to breakdowns, malfunctions, and power outages, which could lead to safe intersections becoming dangerously congested and confusing, therefore resulting in needless accidents. However, a study on the city of Boston calculated that simply reconfiguring the timings of 60 intersections in one district of the city could save US$1.2 million per year, in terms of person-hours, safety, emissions, and energy costs [1]. In situations where malfunctioning occurs, the entity responsible for maintaining the signal may be held accountable, as regions and municipalities have a statutorily imposed duty, which ensure roads are safe for users. Furthermore, the Province of Ontario has set up certain minimum requirements for the maintenance

of roadways, which include standards related to traffic signals, according to Regulation 239/02, which states the Minimum Maintenance Standards for Municipal Highways, under the Municipal Act. However, section 13 of the O.Reg 239/02 stipulates that in cases where a malfunctioning traffic control signal system occurs, the minimum guideline is to "deploy resources as soon as practicable after the awareness of the defect, in order to commence repairs or replacements" [2]. Meanwhile, most regions and municipalities have no statutory in this regards as Ontario, and due to the fact that most of the traffic signals are categorized as isolated intersections, the surveillance system is therefore highly dependent on road users report. Hence, response time needed is longer, especially during out of work hours.

This project focused on designing traffic signal monitoring tools, based on ideas and concepts developed from the research conducted by Sivarao, Subramanian, Ezro and Anand [3] and Marzuki, Ahmad, Buyamin, Abas and Said [4], as well as self-diagnosis techniques, using the Reed-Solomon Codes by Tang and Wang [5]. Furthermore, a monitoring system with Proteus advancement tool, developed in Africa, was also used [6]. However, activities including designing concepts, materials selection, assembling tools, and traffic signal Fig.1

2. RESEARCH METHODOLOGY

The product was designed based on electronic circuit plan, where all blocks were arranged on the project board and tested individually, and also a combination on printed circuit board (PCB) was conducted, at periods of proper function. This study used the Arduino Nano module with ATmega328P as the microcontroller, which was chosen because it simplifies the scenario of traffic signal anomalies, short messages service (SMS) news content, and time settings.

This also facilitates programming, possesses a memory capacity that is capable of accommodating program scripts, it is affordable, readily available, and is relatively small in size. However, programming was carried out using the built-in Arduino IDE open-source software, and the general description of electronic circuit design is seen in Fig. 1 as developed previously [7-9].

The specifications of the designed system are (1) Block system on the transmitter using voltage DC 5V; (2) Uses three types of push button as a simulator to represent three colors of traffic lights; (3) ATMega 8 microcontroller serves as the main controller of the transmitter and performs the role to analyze the push button condition; (4) Using two
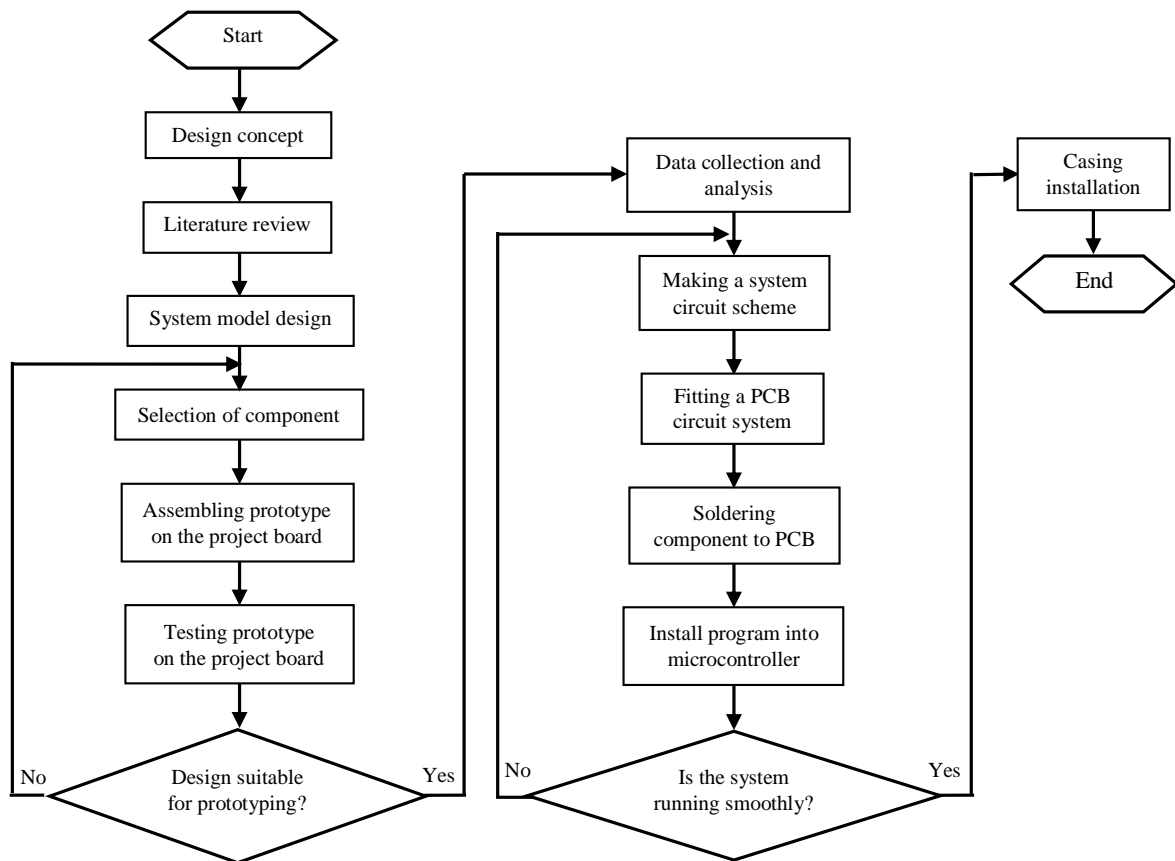

Fig. 1 Design circuit flow chart

units of mobile phone, one as a transmitter and another as a receiver; (5) The system is able to change the signal received by microcontroller into SMS to be used as information code to be displayed on personal computer (Intel Pentium PC 1.80 GHz, 256 MByte RAM, Window XP, and 80 GB HDD); (6) The data display on the computer provides information such as types of malfunction, time of incident, and traffic light location; (7) Communication between mobile phone receivers with PC is designed using serial 8 bit 19200 bps; (8) The system uses Visual Basic 6.0 to display the results of the information it receives; and (9) The system uses Microsoft Office Access 2003 to create databases.

3. RESULT AND DISCUSSION

Each traffic signal display is equipped with a form of light sensor, positioned in a way, in order to detect beams from the traffic signal. This is then processed by the logic gate and microcontroller to be diagnosed, based on the rational state, guard time and verification of the programming anomaly scenario. Furthermore, the microcontroller recognizes the anomaly and immediately turns all traffic signal display (red, yellow and green) off. Meanwhile, during the termination process, the microcontroller instructs the A6 GSM module to dispatch an SMS, at certain time intervals, according to the program (e.g., once every hour) as developed previously in context of documents identification in a library system [10].

Therefore, the emergency light flashes periodically, serving as a visual marker, which indicates that the signal is under repair. Hence, mobile or smartphones can be used as an SMS receiver by entering the recipient's number from the traffic signal in the microcontroller program.

Switching mode power supply (SMPS) with DC 12V 10A voltage was used as the main source. This voltage was chosen to supply the relay and a series of LED lights on the traffic display and emergency flash. In addition, step-down DC to DC buck converter was also applied by reducing the DC 12 Volt voltage from SMPS to DC 5V 3A, which was further used to supply logical state, guard time, data latch, reflected light sensor, GSM A6 module, and the microcontroller as shown in Fig. 2.
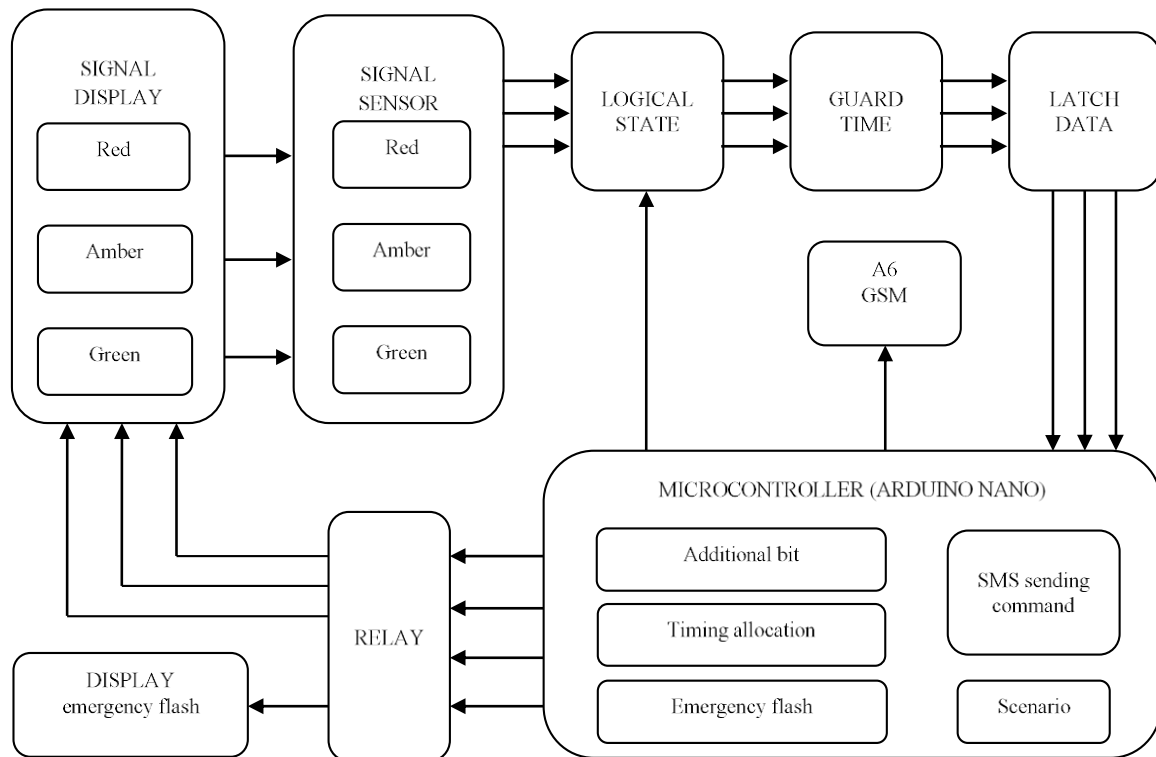

Fig. 2 Devices diagram block

Referring to Fig. 2, a design of electronic series consists of some blocks:

1. The traffic signal display block consists of the combination of a series of light emitted diode (LED) illuminations (red, amber and green), and placed between them are three light dependent resistor sensors (LDRs), used to detect reflections produced by LEDs and other reflectors.

2. The emergency flash display block consists of a combination of LED beams, functioning as visual markers, and the main traffic signal, during the repair process.

3. Reflection sensor block. The readings of each LDR (red, amber, and green) are entered into three voltage comparator circuits. Therefore, if it obtains reflected light, the sensor produces a LOW logic, and on the contrary, a HIGH logic is emitted in the absence of reflected light.

4. The logical state block is an electronic path, which uses an integrated circuit (IC) type CD4028 (BCD to decimal decoder), designed to identify different bits of each sequence of statement traffic signals, in cases of anomaly. Furthermore, the input pin of this IC is a 4-bit binary number (from 0000 to 1111), while the output pin is represented by 10 digits (Y0 to Y9). The following are some identity bits designed for each traffic signal anomaly statement:

4.1. the red display is given the 0101-bit, characterized by pin Y5.

4.2. the amber demonstration specifies the 0011-bit, represented by pin Y3.

4.3. the green exhibition is allotted the 0111-bit, denoted by pin Y7.

5. Guard time block: Anomalous data Y5, Y3, and Y7 cannot be considered valid when in the guard time series, which was allotted a time period of 1 second in this study. For example, if Y5 sends an under-1 second-anomalous signal, it is not considered an anomaly and vice versa.

6. Latch data block: After the validity of the anomaly signal has been considered, the block is then locked (latch). This is further processed by the microcontroller, at the end of a cycle of traffic signal.

7. Microcontroller block: This is divided into five sub-blocks with their respective functions, including:

7.1. timing traffic signal functions as a time allocator per cycle.

7.2. provision of additional bit function for CD4028 IC input (logical statement block), in determining bit during an anomaly.

7.3. anomaly data verification scenario, through the process of matching results of processing data latch blocks with anomalous scenarios, which have been programmed in the microcontroller.

7.4. SMS sending command, when a change in the traffic signal anomaly was considered a malfunction (through the verification process) to be forwarded as news to the A6 GSM module block.

7.5. emergency flash: This sub-block works by flashing, depicting a sign that the main traffic signal is under maintenance.

8. The GSM block A6 module works by sending SMS on the processing results, from the microcontroller to the operator. This occurs because the unit has been recognized by the Arduino library, therefore, it is easily programmed in the IDE, with the AT command instruction set.

9. Relay block is a series, consisting of 4 types of transmissions, while the ULN2803A IC and opto-coupler turns ON or OFF the traffic signal display and emergency flash. These conditions for the four types of relay, follow the order of the microcontroller sub-block timing functions.

The traffic signal cycle in this study followed the sequence as shown in Fig 3.

1. Red OFF, Amber ON, Green OFF;
2. Red ON, Amber OFF, Green OFF;
3. Red ON, Amber ON, Green OFF;
4. Red OFF, Amber OFF, Green ON;
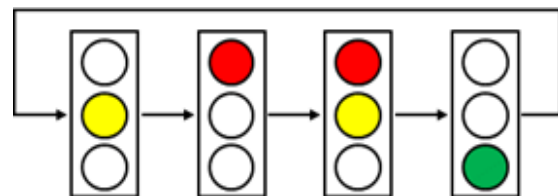5. The second cycle (restarts from Red OFF, Amber ON and Green OFF).

Fig. 3 Traffic signal cycle

Therefore, the implementation of a monitoring system completely as combined work of Fig. 1 and Fig. 2 respectively, is shown in Fig. 4 below.

```
┌─────────────┐
│    Start    │
└─────────────┘
       │
┌─────────────────┐
│ Power ON / Reset│
└─────────────────┘
       │
┌──────────────────────┐
│ Sending opening SMS  │
└──────────────────────┘
       │
┌──────────────────┐
│  Turn on all     │
│  Display lights  │
└──────────────────┘
       │
┌──────────────────┐
│ Start the traffic│
│  signal cycle    │
└──────────────────┘
       │
    ◇ Traffic signal anomaly? ◇  ── No
       │ Yes
┌──────────────────┐
│  Bit anomaly     │
│  identity by     │
│  logical state   │
└──────────────────┘
       │
    ◇ > Guard Time? ◇  No / Yes
```

```
┌──────────────────┐
│  Latch bit       │
│  anomaly identity│
└──────────────────┘
       │
┌──────────────────────┐
│ Microcontroller stops│
│  traffic signal cycle│
└──────────────────────┘
       │
┌──────────────────┐
│ Matching anomaly │
│  scenario by     │
│  microcontroller │
│  devices         │
└──────────────────┘
       │
┌──────────────────────┐
│  Sending anomaly SMS │
└──────────────────────┘
       │
┌──────────────────┐
│ Turn on emergency│
│  flash           │
└──────────────────┘
       │
┌─────────────┐
│     End     │
└─────────────┘
```
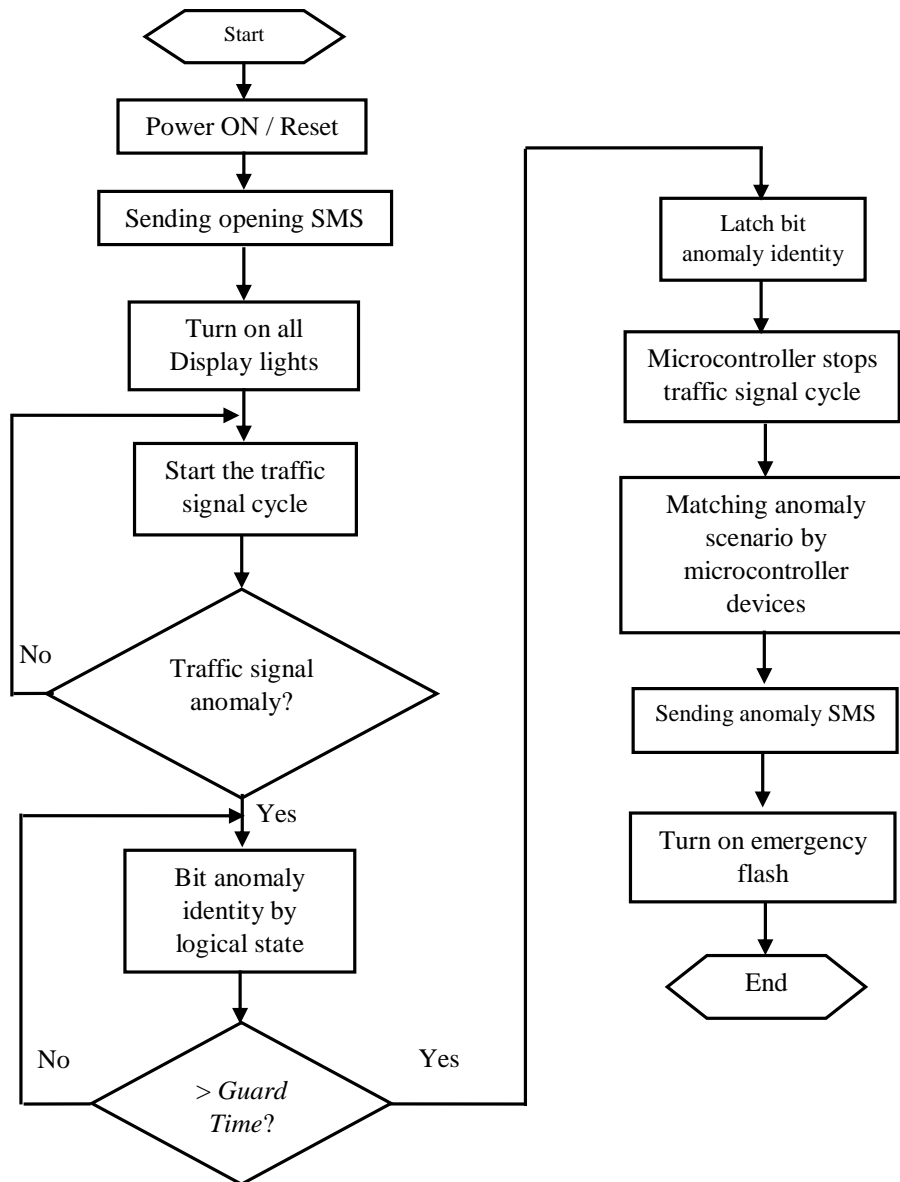
Fig. 4 Flow chart of signal monitoring system

Generally, this system has two main parts. The first part is a station which could be a simulator, a microcontroller (Arduino UNO) or a GSM SIM800L module. It functions as an information provider. While the second part is called a server, which comprises a cell phone or smartphone and a set of computers. This section performs the role of information reception. The traffic monitoring system device is basically designed to quickly inform the traffic light conditions in the event of damage. To speed up information arrival, a wireless communication service is chosen, by using a GSM SIM800L module. The microcontroller will diagnose the traffic lights conditions that are in operation. Some damages have the tendencies of occurrence when the traffic lights operate. Hence they will be programmed on this microcontroller. If there is a corresponding damage scenario, the microcontroller will order the GSM SIM800L module to send information in the form of an SMS about the damage that occurred to the server.

In the early stages of tool design, it is not yet possible to make the equipment ready for use as a whole. This is due to the need to perform simulations in advance and test tools to find the specifications to be achieved. The desired initial stage of achievement in the prototype of the self-diagnosis system of traffic lights is described as follows:
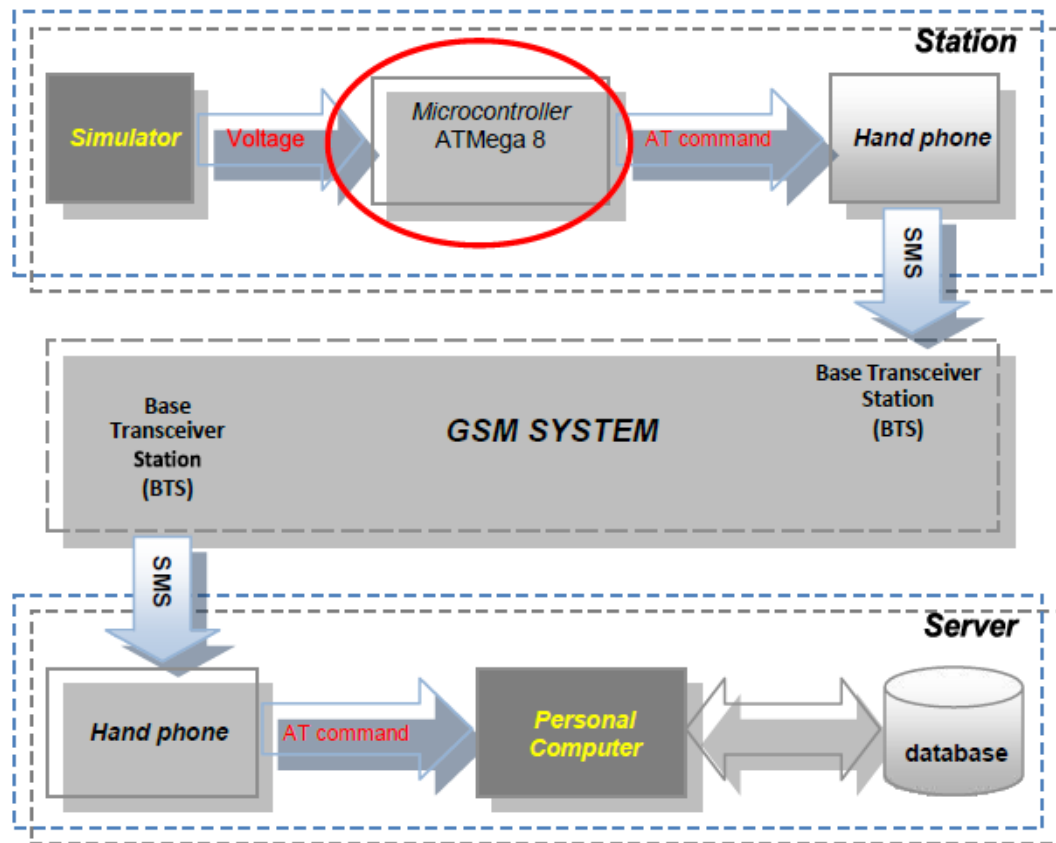
Fig. 5 Self-diagnosis system of traffic light [7]

1. The station section can provide information on its own condition (auto-update) as long as the traffic lights operate normally at a specified time to the server. for example, every 10 minutes the station continuously sends an SMS to the server that the traffic lights are operating normally.

2. The station section can provide information in the form of SMS news immediately to the section in the server in cases of malfunctions in the condition of the traffic lights that are in operation. At this initial stage, an abnormality scenario will be performed with the aid of the simulator section.

The principle behind of this simulator system is designed to replace the functions of real traffic lights. The reason for replacing the overall traffic light with a simulator is to simplify the overall system testing process. The role of the simulator is to prevent a variety of possible damage that may occur at any traffic lights on the highway. At the initial stages of this design, there are two possible abnormalities that can occur at any traffic light.

1. Abnormalities as a result of the break-up of one or more lights, also the occurrence of more than one light at the same time. The state of the light is illustrated by the high logic condition (1), while the condition of the off lights is represented by the low logic condition (0).

2. Abnormalities that occur in the timer system at the traffic light. For example, the red light is simulated for 10 seconds, after which a yellow light is followed for 5 seconds and the green light lasts for 15 seconds. This kind of scenario will be programmed inside the microcontroller. If the traffic lights operation is not in accordance with this scenario, the microcontroller will regard it as an abnormality. Furthermore, the microcontroller will instruct the SIM800L module to send SMS messages to the server that there has been an abnormality in the traffic light timer system.

The simulator section is made up of various parts, namely:

1. Four channel solid state relay (SSR) modules.

2. Arduino UNO, a microcontroller which serves as a diagnostic data processor. It is a storage place for several scenario rules and at the same time giving orders whether or not the GSM module sends news.

3. SIM800L GSM module performs the roles of sending news in the form of SMS results from diagnosis and microcontroller commands to the server. The communication service used is GSM. In this module, you must insert a SIM card that has been topped up and activated the SMS service. This SIM800L module is ordered using AT Command. Library AT Command can be easily downloaded from the official Arduino site. It is an open source,

hence anybody can download it freely and may be used for the development of a programming electronics based on Arduino.

4. The 3-color lamp module, as a miniature of the real traffic lights

5. Switching mode power supply (SMPS), as a 12-volt DC power source and 5 volts to turn on the four previous modules.

4. CONCLUSION

This research highlights the ability to autonomously diagnose traffic signal device systems, especially in its work function, with the intent to detect interference on the device, and provide report via short message service (SMS) to a monitoring unit. Furthermore, this can be placed in any area covered by the Global System for Mobile Communication (GSM) wireless communication service. Meanwhile, a microcontroller was used to process data from the interference detection result, and processing the SMS content, therefore, it is able to quickly inform the types of traffic signal disruptions. Hence, it is possible to utilize this development in building an integrated traffic signal monitoring system services, in the form of mobile applications.

5. ACKNOWLEDGMENTS

6. REFERENCES

[1] Boston Transportation Department. The benefits of retiming/rephasing traffic signals in the Back Bay, 2010, pp. 1-33. http://www.cityofboston.gov/images_docume nts/The%20Benefits%20of%20Traffic%20Sig nal%20Retiming%20Report_tcm3-18554.pdf

[2] Municipal Act, Ontario Regulation 239/02, Minimum Maintenance Standards for Municipal Highways, 2001, pp. 1-10. https://www.ontario.ca/page/government-ontario

[3] Sivarao, Subramanian S. K., Ezro M., and Anand T. J. S., Electrical & Mechanical Fault Alert Traffic Signal System Using Wireless Technology, International J. of Mechanical & Mechatronics Engineering IJMME-IJENS, Vol.10, No.4, 2010, pp.15-18.

[4] Marzuki M. Z. A., Ahmad A., Buyamin S., Abas K. H., and Sain S. Hj. M., Fault Monitoring System for Traffic signal, J. of Teknologi (Science and Engineering), Vol.73, No.6, 2015, pp. 59-64.

[5] Tang X., and Wang S., A Low Hardware Overhead Self-Diagnosis Technique Using Reed-Solomon Codes for Self-Repairing Chips, J. of IEEE Transactions on Computers, Vol.59, Issue 10, 2010, pp. 1309-1319.

[6] Okwu P. I., Mbonu E. S., Ezekwe C. G., and Ajuzie C. U., Quick Prototyping of Real Time Monitoring System Using Proteus Development Tool: A Case for Self Diagnostic Traffic Signal System, African J. of Computing & ICT, Vol.6, No.5, 2013, pp. 147-154.

[7] Purba A., Sulistyorini R., Repelianto A. S., and Ilhami. A., Developing Monitoring System of Traffic Signal Using Microcontroller Device by SMS of GSM Network, Conference Proceeding, in Proc. 1st of Nat. Conf. on SINTA FT UNILA, 2018, pp. 273-277.

[8] Rasha F. K., Traffic Light Control System Using Microcontroller, AL-Qadisiyah J. of Pure Science, Vol.23, No.2, 2018, pp. 269-280.

[9] Kareem T. A., and Jabbar M. K., Design and Implementation Smart Traffic Light Using GSM and IR, Iraqi Journal for Computers and Informatics, Vol.44, No.2, 2018, pp. 1-5.

[10] Kumar R. S., and Kaliyaperumal K., Applications of GSM Technology for Documents Identification In A Library System, International J. of Academic Library and Information Science, Vol. 2 No.1, 2014, pp. 1-6.
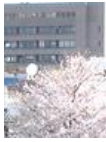
PUBLISHING AGREEMENT

Dear Sir,

I am required to obtain copyright of papers from authors for the term of copyright and I would be grateful if you would confirm your acceptance by signing and returning the agreement below. I will not withhold permission for any reasonable request from you to publish any part of this paper in connection with any other work by you, provided the usual acknowledgments are given regarding copyright notice and reference to the original publication.

If it is appropriate, the author's employer may sign this agreement and, in any event, the employer may reserve the right to use the paper internally or for promotional purposes only by indicating to this agreement.

The author warrants that the manuscript is the author's original work and has not been published before (if excerpts from copyrighted works are included, the author will obtain written permission from the copyright owners and show credit to the sources in the manuscript). The author also warrants that the article contains no libelous or unlawful statements and does not infringe on the rights of others.

If the work was prepared jointly the author agrees to inform co-authors of the terms of the agreement and to sign on their behalf.

Editors-in-Chief

_____

1. Authors' Confirmation (Please answer the followings)

- Q1. Does the abstract contains "background, methodology, results, and conclusions" within 150 words to 250 words? Answer (Yes or No): Yes

- Q2. Have you filled in the gap in all pages (no blank space at all)? Answer (Yes or No): Yes

- Q3. Are the references inside text according to the template? Answer (Yes or No): Yes

- Q4. Are all figures drawn according to the template? (Yes or No)? Answer (Yes or No): Yes

- Q5. Are all figures with the same font size 10 and symbol etc? Answer (Yes or No): Yes

- Q6. Does the paper length at least <mark>6 to 8 pages</mark> or more)? Answer (Yes or No): Yes

- Q7. Are the legends and values of <mark>figures 10 font size</mark>? Answer (Yes or No): Yes

- Q8. Does the list of references according to the <mark>template</mark>? Answer (Yes or No): Yes

- Q9. Does the <mark>copyright</mark> signed by all authors? (Yes or No)? Answer (Yes or No): Yes

- Q10. Are all equations clear and <mark>font size 10</mark>? (Yes or No)? Answer (Yes or No): Yes

- Q11. Does your paper contain at least <mark>10 recent references</mark>? Answer (Yes or No): Yes

- Q12. Have you <mark>proofread English grammar</mark> by a native? Answer (Yes or No): Yes

- Q13. Do you know the following free version of <mark>grammar correction</mark>? Answer (Yes or No): Yes
  https://www.grammarly.com/office-addin/windows

- Q14. Does your paper contain at least <mark>4 tables and/or figures</mark>? Answer (Yes or No): Yes

- Q15. Have you understood <mark>guidelines</mark> given on web page? Answer (Yes or No): Yes

2. Authors' Biography (Please write all authors' full name and biodata here)

Dr. Eng. Aleksander Purba is currently a senior lecturer in the Department of Civil Engineering, Lampung University, Lampung, Indonesia. His email is: aleksander.purba@eng.unila.ac.id

3. Authors' Contributions (Please write all authors' contribution here)

Please state the contributions made by each author in the preparation, development, and publication of this manuscript.

Aleksander Purba and Rahayu Sulistyorini: Idea, basic thinking, acquisition, analysis, and interpretation of data and drafting the article. Agung Ilhami and Ageng Sadnowo Repelianto: Conduct reviewing article and final approval of the version to be submitted.

4. Ethics (Please provide ethical issues that may arise after the publication of your paper)

Author declares that this article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

Name of the Journal:

I hereby assign the copyright to my paper entitled,

DESIGN AND IMPLEMENT A MONITORING SYSTEM OF TRAFFIC SIGNAL USING MICROCONTROLLER DEVICES

+note -

if the paper is rejected, this assignment is null and void

Name of authors: 1. Aleksander Purba 2. Rahayu Sulistyorini   3. Agung Ilhami   4. Ageng Sadnowo Repelianto

Signature: 1   2.   3.   4.

Date: 30 December 2019

Please send this form duly filled and signed together with your manuscript to:

Dr. Zakaria Hossain, Editor-in-Chief

Professor, Division of Environmental Science and Technology

Graduate School of Bioresources, Mie University

1577 Kurima Machiya-cho

Tsu-city, Mie 514-8507, Japan

E-mail: zakaria@bio.mie-u.ac.jp

Tel: +81-59-231-9578

Fax: +81-59-231-9578