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THE CONTROL SYSTEM OF AUTOMATED *KULKUL* BALI BASED ON RASPBERRY PI

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ABSTRACT

Kulkul is one of the traditional means of communication for Balinese people which is still widely used in a special administrative area called Banjar. Banjar is a local community group that acts as a village government system and village council. It is independent to take care of the cultural and religious values of the village community. In Banjar some people are responsible to take care of the affairs of Banjar activities and inform the local community, those people are called Kelian. To inform the local community, Kelian will ring the Kulkul to inform the community that an event has been or currently occurring. Such an event could be the death of one of the families in the community, a call for deliberation, or there has been a disaster in the area. Although Kulkul is still widely used in Banjar, there are few obstacles to being able to ring the Kulkul.To ring the Kukul, Kelian Banjar must be present in Banjar and must climb the Kulkul hall building to ring the Kulkul. Because Balinese people considered Kulkul to be very sacred, only Kelian Banjar is allowed to ring the Kulkul. This could be a problem if Kelian is currently outside of area Banjar and there is critical information such event of a disaster that needs to be addressed to the local community. Seeing the potential for disasters and the importance of the Kulkul in Balinese society. We need to create a system that is capable of controlling the Kulkul remotely from the internet so that Kelian Banjar can ring the Kulkul anywhere and also able to control Kulkul using a keypad so that Kelian Banjar doesn't need to climb the Kulkul hall to ring the Kulkul. In this study. the control system can be controlled using a keypad or from the internet that can perform with 3 types of beat that are beat of deliberation, beat of death, and beat of bulus.
Keywords: Kulkul, keypad, raspberry pi, automated Kulkul

1. INTRODUCTION

Kulkul is one of the traditional means of communication for Balinese people which is still used in some areas or villages. The Kulkul is an instrument that is generally made of wood or bamboo (Pramartha et al., 2018)(Brata & Mantra, 2018). To ring the Kulkul, we must knock the Kulkul with a bat called Kentungan which is usually also made of bamboo or wood. Kulkul is used to inform the public that an event has been or currently occurring (Gantini, 2020). Such an event could be the death of one of the families in the community, a call for deliberation, or there has been a disaster in the area (Jayanthi et al., 2021). To differentiate one event from another, the number and delay of the beat on the Kulkul will determine the type of event that occurs (Kasmawan, 2018).

Banjar is one of the administrative areas in Bali that still uses the Kulkul (Isa et al., 2019). Banjar is a local community group that acts as a village government system and village council. It is independent to take care of the cultural and religious values of the village community. In Banjar some people are responsible to take care of the affairs of Banjar activities and inform the local community, those people are called Kelian. To inform the local community about an event, Kelian Banjar will ring the Banjar Kulkul with a beat that corresponds to the event that is happening or will be held (Ngurah Desnanjaya et al., 2020). For example, to inform the public that there will be a regular meeting in the Banjar or deliberation, Kelian Banjar will do the beat of deliberation or knock musyawarah by knocking the Kulkul 7 times with a delay of 2 seconds for each beat. To notify the public that one of the families in the Banjar has died, Kelian Banjar will do a beat of death or knock kematian by knocking the Kulkul 6 times with a delay of 2 seconds for each beat. And to notify the public that a natural disaster or crime has occurred, Kelian Banjar will do a beat of bulus or knock bulus by knocking the Kulkul for 1 minute with a delay of 1 second for each beat.

Although Kulkul is still widely used in Banjar, there is a few obstacle and weakness to being able to ring the Kulkul. To ring the Kulkul, Kelian must be presence in Banjar and must climb the Kulkul hall building to ring the Kulkul (Desnanjaya & Sudipa, 2019). Because Balinese people considered Kulkul to be very sacred, only Kelian Banjar is allowed to ring the Kulkul. This could be a problem if Kelian is currently outside of area Banjar and there is critical information such event of a disaster that needs to be addressed to the local community. Seeing the potential for disasters and the importance of the Kulkul in Balinese society. We need to create a system that is capable of controlling the Kulkul remotely from the internet so that Kelian Banjar can ring the Kulkul anywhere and also able to control Kulkul using a keypad so that Kelian Banjar doesn't need to climb the Kulkul hall to ring the Kulkul.

The system will use Raspberry Pi 3 as the main processing unit. Raspberry Pi 3 is an inexpensive, small, and portable single-board computer that mostly has the same capability as an ordinary computer (Yattinahalli & Savithramma, 2018). Raspberry Pi 3 computing power is powerful enough to create most of the Internet Of Things projects. One of the reasons this research uses Raspberry Pi 3 is that this single board computer has a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor that allows us to do parallel programming so that any data can be processed faster (Ravindran et al., 2021). Another reason is Raspberry Pi 3 is capable of any kind of serial communication protocol like I2C, SPI, or UART, This will make Raspberry Pi 3 easily work with any kind of electronic module on the market (Purwanti et al., 2021).

2. RESEARCH METODOLOGY

2.1 System Development Life Cycle

Systems Development Life Cycle (SDLC) is a structured management framework or model that outlines the phases required to build a system, from start to finish (Garg et al., 2022) (Suryantara & Andry, 2018). In this research we use the system development life cycle method shown in Figure 1, with the following stages:

Figure 1. SDLC Method
Source: medium.com, 2022

A. Planning

From the introduction section, there is 2 main problem that needs to be solved that is *Kulkul Banjar* can't ring if *Kelian Banjar* is not presence in the area, and in order to ring the *Kulkul*, *Kelian* must climb the *Kulkul* hall and ring it manually. From these problems will be designed a system that can control *Kulkul* remotely from the internet and also be able to control *Kulkul* using a keypad.

B. Analysis

After knowing the problem and making a general understanding of the system. in this stage will analyze what is needed to design and build the system. Equipment and material requirements are; Raspberry Pi 3 B, GSM Modem, Keypad 4x4 Module, Buzzer Module, LCD16x2 + I2C Module, Motor Driver Module (BTS7960), Motor Power Window, and Limit Switch.

C. Design

After done analyzing what equipment and material are needed. In this stage will design a sketch of how the workflow of the system works, how each component is connected to each other, and how the system will look physically.

D. Implementation

The next step is to implement the design that has been created. There are a few steps in this stage, namely; preparing tools and material, installing all necessary software and library, setup all component module, system coding, system configuration, and system testing.

E. Testing

The next stage is to test it. The purpose of this stage is to test whether the system can overcome the problem according to the planning stage. If the system works well, the system will be implemented and will be reviewed by the user.

F. Maintenance

After testing and integration, the system will be updated or maintained if the user wants to add additional features that are needed in the previous system. So that the previous system will continue to be better.

2.2 Block Diagram

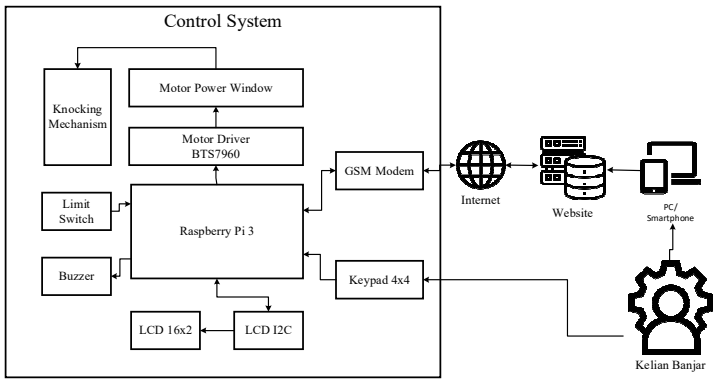

Figure 2. Block Diagram Of The Control System

Block Diagram is a diagram that describes the working principle of the entire system. Figure 2 Is a block diagram of the overall system design. In Control System we use the following component: Raspberry Pi 3 as main processing data, GSM Modem allowing raspberry pi to connect with internet, Keypad 4x4 as an input device for the user, buzzer as an output that produces sound each time any key in keypad has been pressed, LCD 16x2 as an output that will produce a display of what user has been inputting from the keypad, LCD I2C as an adaptor that allowing Raspberry Pi

3 to control the display of LCD 16x2 using I2C protocol, Motor Driver (BTS7960) allowing raspberry pi to control the speed of Motor Power Window, and Limit Switch as a sensor that detects if a knock has been occurring. There is also a Knocking Mechanism that will responsible for converting the rotation of the Motor Power Window to a knocking movement. The limit switch will be attached to the knocking mechanism to detect if a knocking movement has been occurring. Each time it occurs limit switch will send a signal to Raspberry Pi 3, and using that signal Raspberry pi 3 can count how many and long knocking movement has occurred
To access the control system, users have 2 choices. That is accessing from the internet or accessing using a keypad. To access it from the internet, the user needs to log in to a website and input the credential. If the login was successful then the website dashboard will appear and from there, the user can choose what type of beat that user wants to send to the control system. There is 3 types of beat command that are beat of deliberation, beat of death, and beat of *bulus*. After choosing the beat type, the user will click the button of that particular beat type and then that will send a command to the control system to execute the knocking procedure. If the user wants to access the control system directly from the keypad. First, the user must enter the passcode using a keypad. If the passcode is valid then the control system will prompt the user using a display from LCD 16x2 that the passcode is valid. In a few seconds, the user will be prompted by the control system to press a key on the keypad between 1 to 3. Key 1 will be correspondence to knocking of deliberation, Key 2 will be correspondence to knocking of death, and key 3 will be correspondence to knocking of *bulus*. Users need to choose 1 of these keys to press, then after pressing it the control system will execute the knocking procedure.

2.2 Schematic

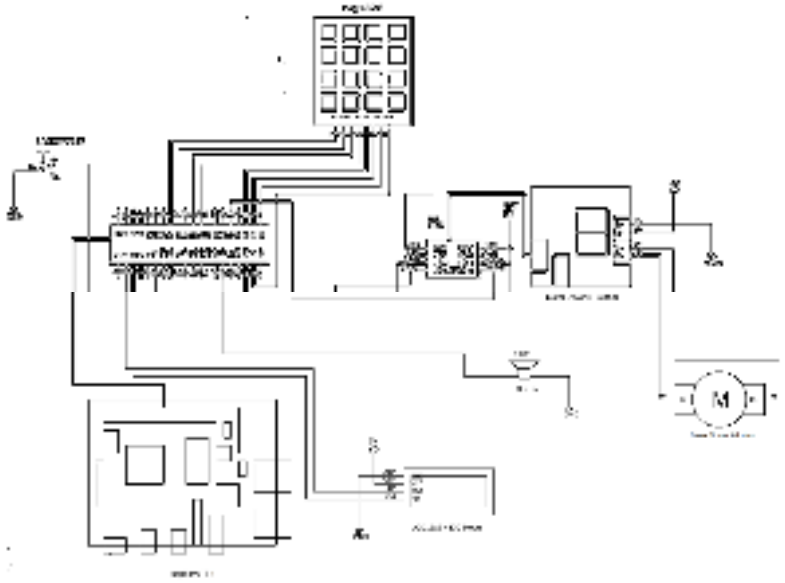

Figure 3. Schematic Of Control System

Figure 3 is a design of the schematic that describes how each component is wired in the control system. Keypad pin from 1 to 8 will be connected to raspberry pi through GPIO 16,18,22,24,36,38,40,37. LCD I2C module will be directly mounted to LCD 16x2 then SDA and SCL pin will be connected to GPIO 3 and 5, these GPIO pins are capable to use I2C communication protocol. LCD I2C VCC and GND will be connected to a 5v pin and Ground pin on raspberry pi. Buzzer positive terminal will be connected to GPIO 29 and pin Ground pin on raspberry pi. For Limit Switch will have 2 terminals, 1 terminal will be connected to GPIO 11 and the other terminal will be connected to the Ground pin in raspberry pi. And for BTS 7960, pin VCC, L_EN, and R_EN will be connected to the 3.3 v pin on raspberry pi, the Ground pin will be connected to pin Ground pin on raspberry pi. And pin LPWM and RPWM will be

connected to GPIO 35 and 32 on raspberry pi.B+ and B- terminals will be connected to power source 12 v and Ground of Raspberry Pi 3. And M+ and M- will be connected to the positive side and negative side of the Motor Power Window.

3. RELATED RESEARCH

This research can be done thanks to references from the results of previous research that have been carried out. One of that research is from a journal entitled “The Control System of Kulkul Bali Based on Microcontroller” made by Desnanjaya et al, (Desnanjaya & Sudipa, 2019). In this journal, the researchers can make a system that can control Kulkul remotely using SMS. This system uses Arduino UNO as the main data processing and SIM900 which is used to send or receive SMS. The way this system works, first of all, the user will send a beat command SMS to the number registered on SIM900. The contents of the SMS will determine what type of beat will sound. For example, the user will send an SMS containing the number 1 then the system will execute the beat of death or knock kematian. After sending the SMS, the SIM900 receives the SMS and will forward the data to Arduino UNO to perform the process of knocking the Kulkul according to the incoming SMS.

Another reference is from the journal entitled “Home security monitoring system with IoT-based Raspberry Pi” made by Desnanjaya et al, (Ngurah Desnanjaya & Arsana, 2021). In this journal, researchers can make home monitoring systems that can monitor and send users notices about the condition of their homes at the same time. This system uses raspberry pi 3 as the main data processing, DHT 22 module as a temperature and humidity sensor (Desnanjaya et al., 2022), a PIR sensor to detect any movement, and a raspberry pi camera module to take a picture. This system also utilizes the feature telegram bot to send commands or to receive a critical notification. On standby, raspberry pi will wait for the command to come from the telegram bot. Users can command the raspberry pi to send the current temperature or take a picture. If the PIR sensor detects any movement, raspberry pi will take a picture immediately and send it to the user. Also if the humidity that DHT 22 produce is greater than 300ppm the raspberry pi will send a notification that gas density is at a dangerous level.

4. RESULT AND DISCUSSION

After designing the system, now we will implement the system based on the design. Control System will have 2 main parts, which are a box controller and a knocking mechanism.

Figure 4. Box Controller and Knocking Mechanism;
(a) Box Controller view from the front, (b) Box Controller view from the inside, (c) Knocking Mechanism

To find out if the system is working correctly, will do the testing by accessing the control system via the internet and keypad. We will do 3 types of beats namely; the beat of deliberation, beat of death, and beat of *bulus*. We also want to calculate the average time of sending a command from the website to the control system. We will send the command beat of death from the website 5 times and calculate the average times between the times of sending the command until the control system starts executing the command.

Table 1. Accessing and Controlling Control System From Website

Command	Control System	Result
Knocking Of Deliberation	Motor Power Window Moves to knock the *Kulkul* for 7 times	Beat Of Deliberation successfully rang
Knocking Of Death	Motor Power Window Moves to knock the *Kulkul* for 6 times	Beat Of Death successfully rang
Knocking Of *Bulus*	Motor Power Window Moves to knock the *Kulkul* for 1 minute	Beat Of *bulus* successfully rang

Table 2. Accessing and Controlling Control System Using Keypad

Command	Control System	Result
Press Key 1	Motor Power Window Moves to knock the *Kulkul* for 7 times	Beat Of Deliberation successfully rang
Press Key 2	Motor Power Window Moves to knock the *Kulkul* for 6 times	Beat Of Death successfully rang
Press key 3	Motor Power Window Moves to knock the *Kulkul* for 1 minute	Beat Of *bulus* successfully rang

Table 3. Average Time for Send Command From Website

Testing	Sending Time	Executed Time	Deviation
1	18:28:34	18:28:36.3	2.3s
2	18:30:52	18:30:55.9	3.9s
3	18:31:54	18:31:57.6	3.6s
4	18:32:50	18:32:55.7	5.7s
5	18:34:41	18:34:43.9	2.9s
Average Time			3.68s

5. CONCLUSION

Based on the result of research that has been done on the system, it can be concluded that. In developing the system, will use the SDLC method. There are a few stages namely; the planning stage, analysis stage, design stage, and implementation stage. Testing stage and maintenance stage. From the testing session it was found that the control system can be accessed both from the website and using a keypad to execute 3 beats type that is; beat of deliberation, beat of death, and beat of *bulus*. Also, from sending the beats command from the website 5 times, It was found the average time to send the command is 3.68 seconds long.

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