Teacher Resource Bank

GCE Electronics

Sample Coursework

- Sample One

AQA

Centre-assessed work
Candidate record form
2009

GCE Electronics (2430)
Unit 3 Practical system development (ELEC3)

Centre number _____ Centre name _____

Candidate's full name _____ Candidate number _____

Notice to candidate The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

To be completed by the candidate

1. Have you received any help or information from anyone other than your subject teacher(s) in the production of this work?
   Yes ☐ No ☐
2. If you have answered yes, give details below and on a separate sheet if necessary.

3. Any books, leaflets or other materials (eg DVDs, software packages, Internet information) used to help you complete this work and not clearly acknowledged in the work itself must be listed below. Presenting materials copied from books or other sources without acknowledgement will be regarded as deliberate deception.

Candidate declaration I have read and understood the above and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

As part of AQA's commitment to assist students, AQA may make your coursework available on a strictly anonymous basis to teachers, examining staff and students in paper form or electronically, through the Internet or other means, for the purpose of indicating a typical mark or for other educational purposes. In the unlikely event that your coursework is made available for the purposes stated above, you may object to this at any time and we will remove the work on reasonable notice. If you have any concerns, please contact AQA.

Candidate signature _____ Date _____

Teacher declaration I confirm that the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

Teacher signature _____ Date _____

This form should be attached to the candidate's work and retained at the centre or sent to the moderator as required

ELEC3/CRF

Turn over ▶

Candidate's full name

Candidate number

To be completed by the teacher / assessor and candidate

On each occasion when you and your supervisor discuss your coursework, details of the consultation should be recorded. The record should begin as soon as you start on the coursework, i.e. when the form of the experimental project is being chosen and should be completed when the written report is submitted to your supervisor for assessment.

Date discussion took place	Nature of Discussion (e.g. advice, guidance and help given by the supervising teacher)

I certify that the above is a record of the candidate's work.

Date

Turn over ▶

Candidate's full name

Candidate number

To be completed by the teacher

Marks must be awarded in accordance with the instructions and criteria in the specification. The work **must** be annotated to identify the relevant evidence.

Project title:

Please complete the boxes with the appropriate mark for each criterion.

A Problem analysis and solution design

	mark	comment
a		
b		
c		
d		
e		
f		
g		

B System development

	mark	comment
a		
b		
c		
d		
e		
f		
g		
h		
i		

C Making measurements

	mark	comment
a		
b		
c		
d		
e		
f		

D Report

	mark	comment
a		
b		
c		

Total mark (max 50)

Details of additional assistance given (if any) Record here details of any assistance given to this candidate which is beyond that given to the class as a whole and beyond that described in the specification. Continue on a separate sheet if necessary.

Concluding comments

To see how AQA complies with the Data Protection Act 1988 please see our Privacy Statement at aqa.org.uk

Candidate's record of the supervision of coursework.

NAME:-..... .....

REFERENCE NUMBER:-..... .....

On each occasion when you and your supervisor discuss your coursework, details of the consultation should be recorded. The record should begin as soon as you start on the coursework, i.e. when the form of the experimental project is being chosen and should be completed when the written report is submitted to your supervisor for assessment.

Date when discussion took place	Content of discussions; advice, guidance and help given by the supervising teacher.
21 Jan 08	course outlined by the teacher.
28 Jan 08	Project aim agreed with supervisor.
11 Feb 08	Completed sub system 1
26 Feb 08	completed sub system 2-3
6 March 08	measurement / fault finding done
10 March 08	Project demonstrated to supervisor.
11 March 08	testing the circuit done
13 March 08	Modifications done
8 APRIL 08	Final project report submitted to supervisor.

Bi2
System worked and no evidence of teacher assistance.

I certify that the above is a record of the candidate's work.

Supervisor's signature:..... .....Date:..12/5/08.

Electronics AS level

Problem

The problem which I have chosen to work on is that when it goes dark we can't see because we need light to see so we use lamps or light bulbs but lamps and light bulbs need electricity which is expensive.

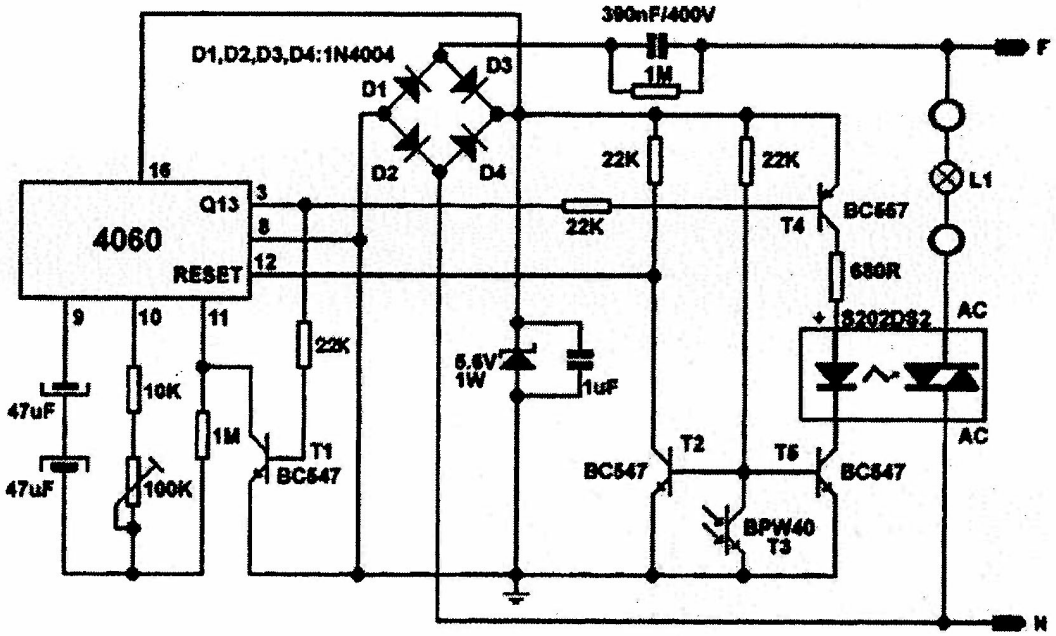
Aa2
Just!

So to over come this we need a light source that uses less electricity and turns on automatically when it goes dark. From my own experience I have found that I some times forget to turn the lights off when I go to sleep. So I have decided to design and make an electronic circuit which turns a light on when it goes dark and then turns it off after a set time so it doesn't stay on all night long.

Research

I have searched the internet and electronic magazines in my school library to find any products which do same or similar functions as the circuit which I will design which are shown below.

Automatic Lamp Control with Light Sensitive Switch



Description:

The circuit above is a light sensitive automatic switch which functions in absence of light. The IC 4060 works as an oscillator and the generated signal is applied to the base of T4 transistor. Phototransistor T3 is in conduction by existence of light and it keeps the T5 transistor's base at ground potential.

When no light reaches the phototransistor, it gets in insulation. T3 reaches positive potential through 22kohm. T4 and T5 both get in conductance. The oscillator signal reaches the optic coupler and lamp(s) shines.

(Source: www.circuit-projects.com)

Wall Light

This light is fitted with an integral P.I.R (passive infra-red) unit which automatically turns the light on when it detects movement. IP Rating 43. There is a facility to adjust the amount of time for the light to stay on. There is also a lux adjustment to set the sensitivity of the detector according to the illumination of the surroundings.

All our security lights have a manual over-ride facility. If the light switch is turned on and off twice in quick succession the light will stay on permanently. To revert back to sensor mode turn the light off for 5 minutes and then back on.

Light specification:

Dimensions: Height 240mm, Projection 140mm, Width 250mm

Bulb(s): 1 x 75W E27 GLS (not included)

(Source: www.lightsuk.com)

Ab1
Adequate details from the first source, but the second is too weak.

The street lamps

The street lamps all over UK are light sensitive they automatically turn on when it gets dark I don't know what their circuitry is or how they work because I could not find a retailer who sells them to find out their specification.

Inadequate

(Source: me)

Research

1) At what light intensity should my circuit be turned on.

2) What colour of LED is most susceptible to eyes

At what light intensity should my circuit be turned on.
To find out at what light intensity should my circuit be triggered I used a light sensor.

First I measured the light intensity of the room where I was and could see every thing clearly. The light intensity of the room was 30% of the light sensor being next to a very bright light. Then I placed the light sensor on the table and started reducing the amount of the light reaching the light sensor by covering it by my hand until only the amount of light was reaching the light sensor in which I thought we wouldn't be able to see the light intensity was 10%. In order to set the sensitivity of the circuit I will place the light sensor next to LDR of my circuit and cover both until the light intensity dropped just above 10% I will set my circuit to trigger at that light intensity.

What colour of LED is most susceptible to eyes
I have learned that the light bulbs waste electricity and only produce 10% of the visible light from the light they produce but LED's or fluorescent lamps don't waste that much energy so I have chosen to use a coloured LED which is most susceptible to human eyes. According to Wikipedia we can see the wave lengths of light 380-750 nano meter the colours of which are

Colour	Wavelength	Range
Violet	380–450 nm	120
Blue	450–495 nm	45
Green	495–570 nm	75
Yellow	570–590 nm	20
Orange	590–620 nm	30
red	620–750 nm	130

Ac0
The first investigation needs to have actual light measurements in Lux.
The colour most susceptible to eyes was not conducted practically and so is not valid.

As you can see from the table

above that we are able to see red light more than any other colour so I have chosen to use a red LED which will be a source of light when it will go dark.

Ae0
Timing not specific.
Current unrealistic
Supply voltage OK.

(Sources: www.howstuffworks.com / www.wikipedia.com)

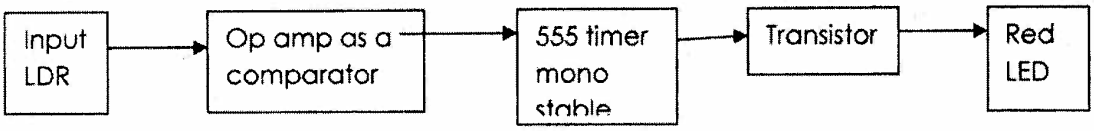
Specification

It must turn on when it goes dark for a specific time (2-3 hours) then automatically turn off so it should have an electronic switch a timing circuit and it must use red LED. The prototype must use low voltage and current which will be safe i.e. around 0-15 volts. The total current of the circuit should be with in 0 to 4mA and it stay on for the specified time. I am not going to wait 2-3 hours for the circuit to turn off so will set the time for only few seconds.

Possible solutions

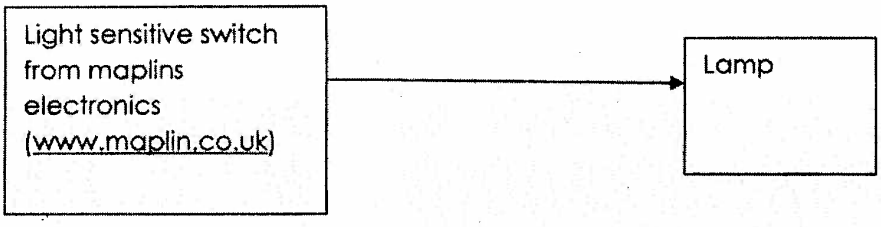
Ad1
Just worth 1 mark

system A



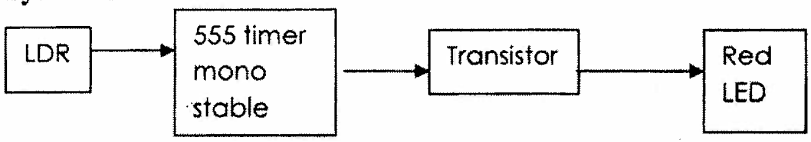
The OpAmp will compare the voltage coming LDR with a resistor in series and a potential divider and will trigger the 555 timer mono stable which will time to a specific value dependent on the value of resistor and capacitor in series. It triggers the transistor which in turn turns on the LED and turns it off.

System B



The maplin electronics sell a premade circuit which is light sensitive and turns on at dusk and turns off at down.

System C



Af1
System C not valid.
System A and C OK but no mention of why C was not used.

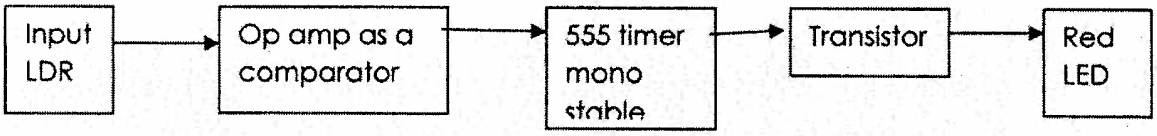
Reasons for choosing the system for development

I have chosen to make system **A** because in system **B** the electronic switch will only turn on at dusk and then turn off at down but if for some reason it goes dark at day time for example when a solar eclipse or when it goes so cloudy that it looks as if it is night so the electronic

Ag0
Inadequate details of the reason for the choice.

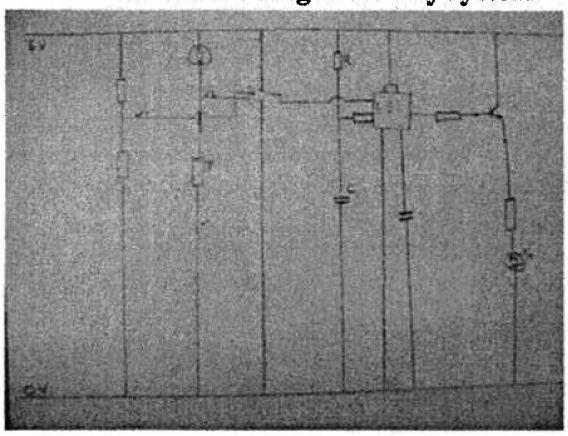
switch will not turn on the lamp according to the specification of the circuit. I must have three active devices in my circuit and the other two circuits don't have enough active devices in them.

Development



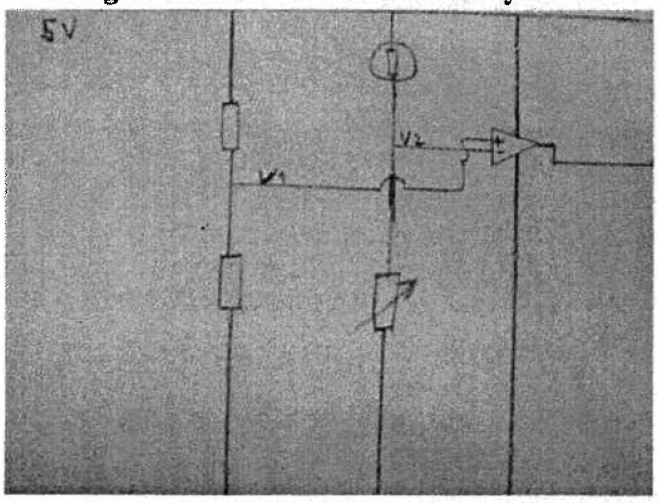
As you can see from the diagram above that my system is made using sub systems.

Below is the circuit diagram of my system



Development of the first sub system

The diagram below shows the circuit lay out of the first sub system



Ba2.
Just sufficient for 2 marks

Bd0
Details of the system are sketchy and incomplete.

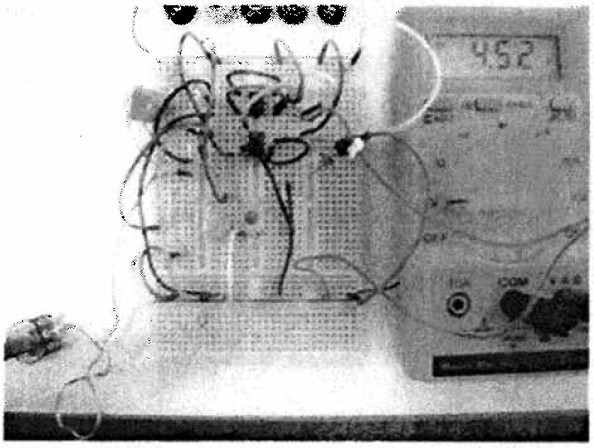
My first circuit is an opamp as a comparator it will compare voltage between two voltage dividers. One voltage divider is two resistors of same value in series and second is a LDR and variable resistor in series. (See diagram above) When V1 is more than V2 it will give me out put voltage of less than 2 volts the voltage at V2 will stay at around 2.5 volts. I will use the

variable resistor to set the sensitivity of the circuit.

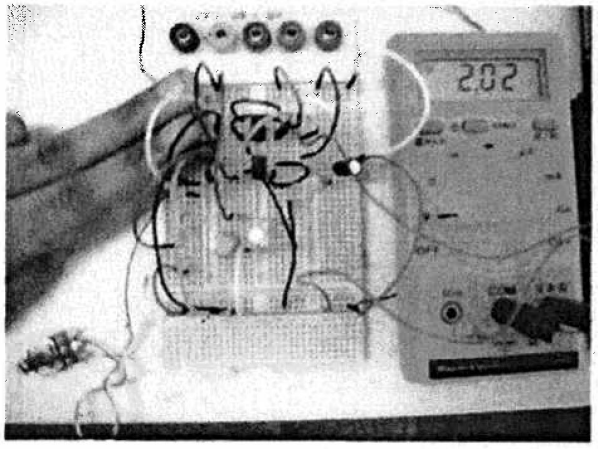
The photo graph below shows my first sub system built

Now that I have built my first sub system I must now build my second sub system but first I need to find out if my first sub system will trigger my second sub system the out put of my first sub system should be lower than one third of the supply voltage I am using 5v power supply one third of that is 1.6 in theory voltage lass than one third of the power supply at the trigger of 555 timer should trigger it but in practise you need it to be much lower than that. The measurement that I did on my circuit are shown below in photographs

The picture below shows the out put of my first sub system when circuit is not on



The picture below shows the out put of my first sub system when circuit is on or triggered



Bc2
Two measurements.
Just sufficient.

As you can see that my when the circuit is triggered the out of OpAmp is 2.04 volts which is way more than what I need to trigger the 555 timer so I have decided to put in a resistor in series with the diode to make it drop more in order to trigger the 555 timer.

Calculating the resistor value

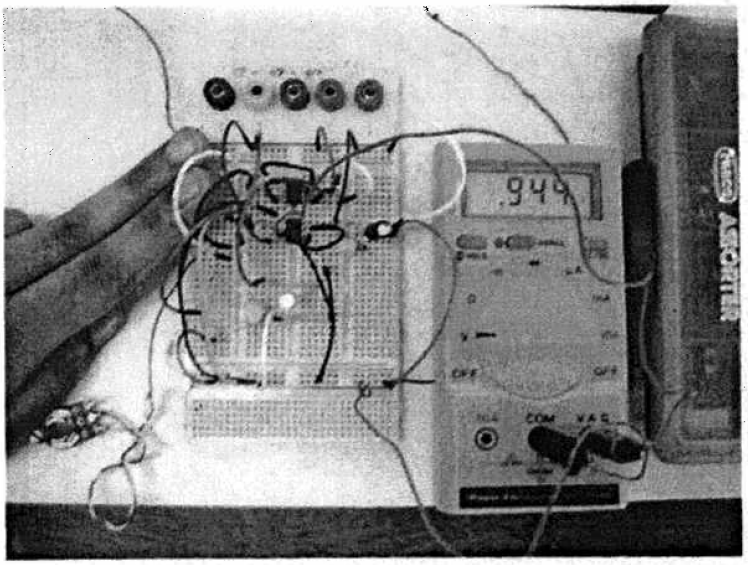
I have 2.04 volts as out put from OpAmp I need to drop it to 1.5 volts in order to trigger the 555 timer.

So (R= V ÷ I) so 2.04 – 1.5 = 0.54 then the current is 0.3 micro amps so 0.54 ÷ 0.3 = 1800000 so according to this calculation I need 1.8 Meg ohm resistor which luckily is one of the preferred value

Bb2
Calculation OK even if there is an issue with circuit.
No earlier reference to diode.

As I calculated the value of the resistor above I used it in front of the diode but it did not work when I triggered my circuit by covering the LDR but when I connected in the multi meter at the input of the 555 timer to see if the voltage was dropping down enough to trigger the 555 timer and I covered the LDR while putting in the wire from the multi meter the circuit got triggered and the 555 timer behaved as I expected it to but when I took the wire out from the multi meter and triggered the circuit it did not work so assuming that the multi meter was behaving as a big resistor so I used the biggest resistor in value I could find and tied it down to the 0 volt rail and triggered the circuit and it worked. And now when the circuit is triggered the input at trigger pin of 555 timers is just above 0.9 volts which is sufficient enough to trigger it.

The picture below shows the input at the trigger pin of the 555 timer



Be1
Photograph shows reasonable layout, but it is not annotated or particularly clear.
It would have been better if this had been produced larger and then labelled.

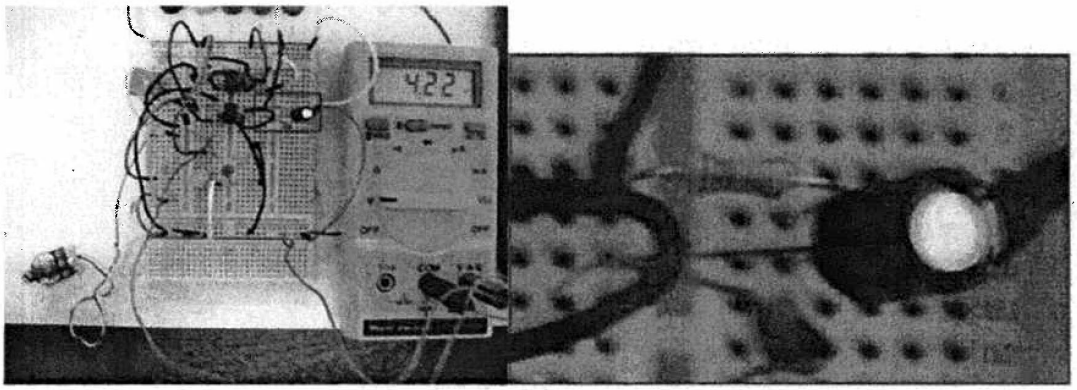
Building of the second sub system

I already have built the second sub system I need it to check if the first sub system was capable of triggering it. The second sub system is a 555 timer mono stable when triggered is responsible for turning on the transistor for the set time. To set the time I used the equation $T = 1.1 \times R \times C$ in reality if I designed the circuit I would want the LED's to stay on for quite a while after it has gone dark but in this situation I have decided to keep them on for only 5 seconds the calculation which I did is shown below.

Bb2
A better example of a component calculation.

Calculation of time

I used a random capacitor with the value of 220 micro farads. I wanted to keep the circuit on for 5 seconds. I have the capacitor, I just need to find the right resistor to go with it in order to keep my circuit stay on for 5 seconds. The equation which I am going to use to calculate the value of resistor is $T \div (1.1 \times C) = R$ as you may have noticed it is rearrangement of the original equation above to calculate the time. So which makes my numerical equation to be $5 \div (1.1 \times (220 \times 10^{-6})) = 20661$ as you already know this not one of the preferred value of resistor so I have decided to use a 22k Ω resistor. As you can see in the picture below.



Testing

The test plan

Obviously first of all I will find out does the circuit behaves as I wanted it behave.

I have decided to make a test plan in a form on a table which I will print and then check if my circuit works how it is suppose to.

Ca1
Generous!
Only a superficial attempt at a testing plan

Does the circuit turns on when it goes dark	
Does the circuit stay on for the amount of time	
Does the circuit times to the amount of time I set it to	
Does the circuit meets the initial specification	

Testing

In my specification I mentioned that "I have decided to design and make an electronic circuit which turns a light on when it goes dark ~~and then turns~~ it off after a set time so it doesn't stay on all night long." So to find out that does it turn on I will cover the relative component to see if it turns on the LED.

I covered the LDR to see if the circuit gets triggered?
The circuit triggered when I covered the LDR and stayed on for few seconds and then turned off.

And does it stay on for the set time which I chose for it to stay on for this I took some readings from the circuit. Which are shown below:

The time I chose for the circuit to stay on was 5 seconds.

To investigate that my circuit stays on for the time I chose for it to stay on if timed my circuit using a stop watch after triggering it. I timed the circuit the times the circuit stayed on for the time lengths shown below.

6.02
5.62
5.93
5.79
5.89
5.95

Cb1
Measurements are made but are incomplete. There should be a light measurement, range of power supply voltages, supply current etc

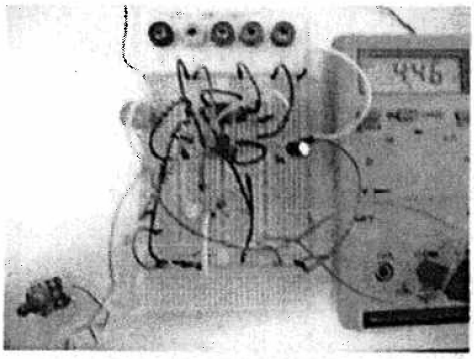
Cc0
Only basic testing

The average time my circuit stayed on is 5.87 seconds which I believe is very good because considering my rate of my reaction of starting and stopping the stop watch the original average would be much closer to 5 seconds.

Does the circuit turns on when it goes dark	**Yes**
Does the circuit stay on for the amount of time	**Yes**
Does the circuit times to the amount of time I set it to	**Yes**
Does the circuit meets the initial specification	**Yes**

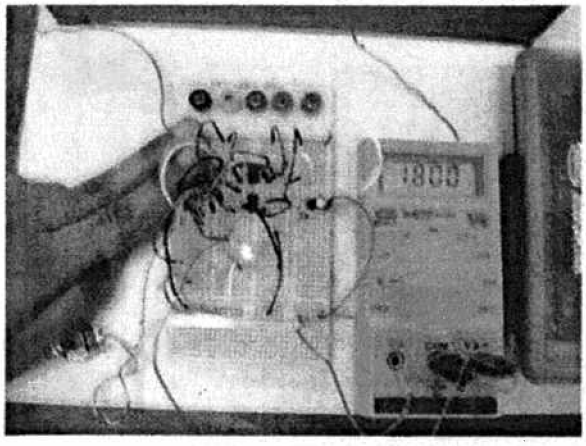
Measurements
The measurements I have taken are shown in the pictures below.

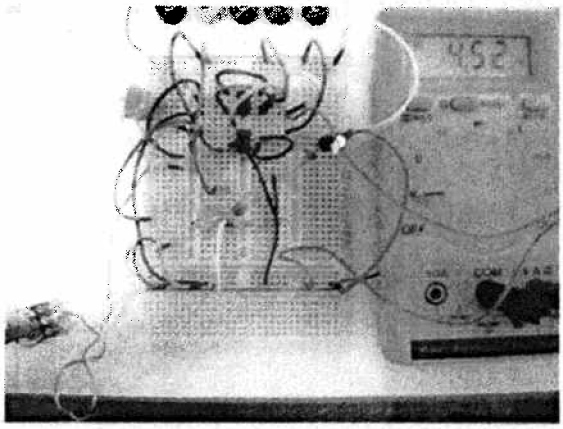
I took the measurements of inputs and out puts of my all sub systems to see if they were at appropriate voltages when the circuit was triggered and when it was not triggered.



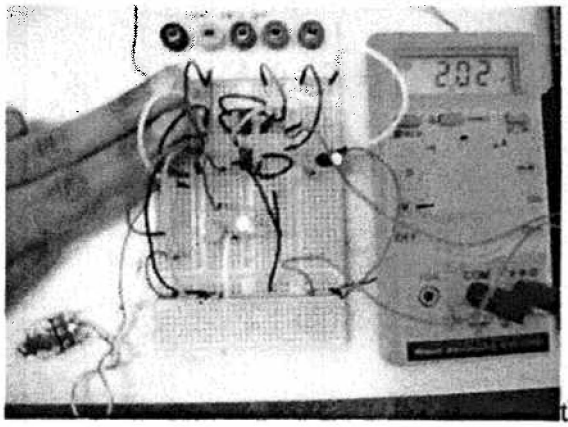
As you know V1 (see circuit diagram of my system) is always 2.5 it is essential that the voltage at V2 is higher than V1 so the OpAmp is giving out higher voltage so the 555 timer is not triggered. And when the circuit is triggered by covering the LDR it should be lower than V1 so the OpAmp gives out less voltage which

allows the 555timer to turn on. The picture below shows the voltage at V2 when the circuit is triggered. (V2 is connected at the 3rd pin of the OpAmp and V1 is connected at 2nd pin of the OpAmp.)

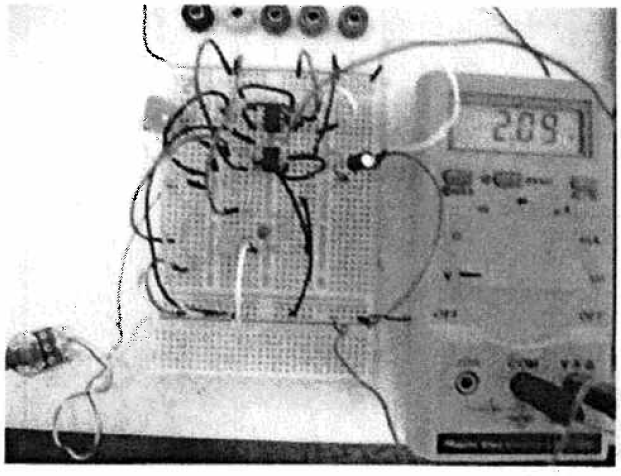




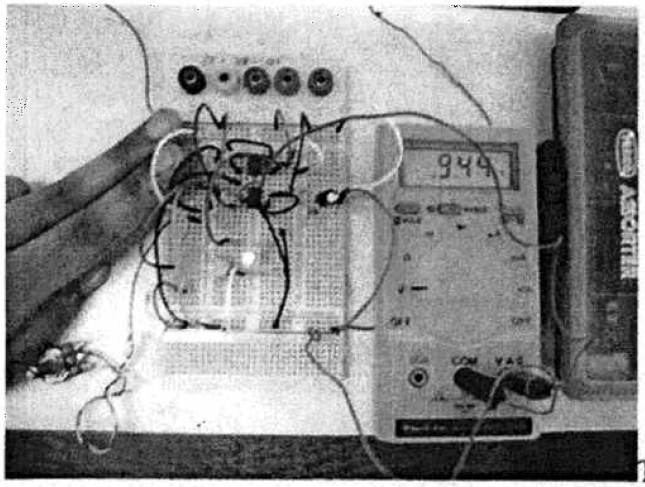
The picture shows the out put of the op amp when the circuit is not on. The out put of op amps is what I expected it to be.



the picture shows the out put of the op amp when the circuit is triggered. The out put of the op amp when the circuit is triggered is higher than what I wanted it to be so I have placed a resistor in series with it to drop the voltage but it did not work and I have already explained what I did next above.



The picture shows the input to the 555timer when the system is not on after the voltage has been dropped by the resistors.



There is an error with these current measurements. 4mA is unrealistic anyway.

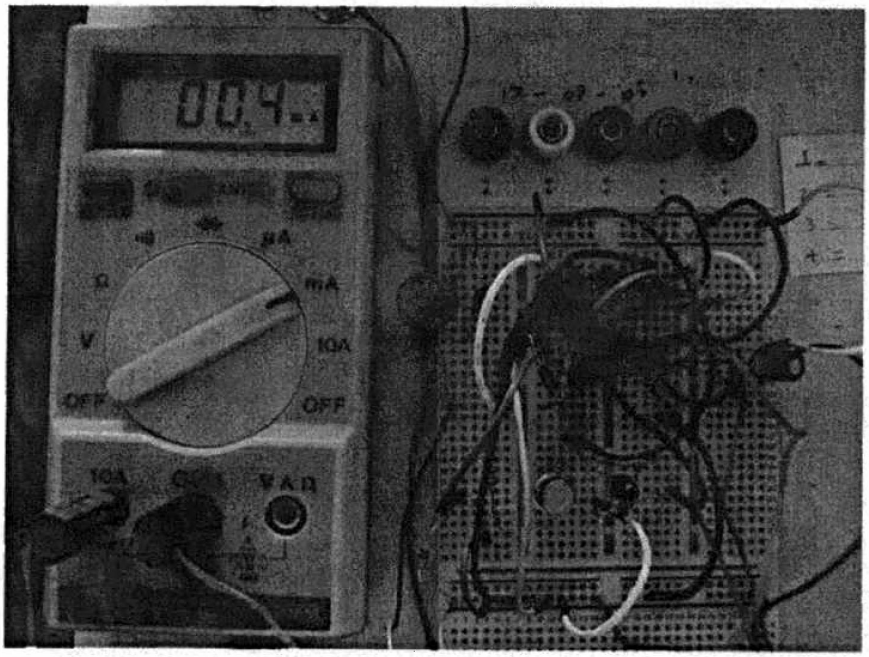
The picture shows the input to the 555timer when the circuit is triggered. As you can see the voltage is sufficient to trigger the 555timer which is turning on the transistor which is powering up the LED. I took an additional reading the find out the total current of the circuit and found that when the circuit is triggered the current is 0.3miliamps and when the circuit is not on the current of the circuit is 0.1miliamps which is what I wanted it to be i.e. from 0 to 4miliamps which is to safe to work with.

Cd1
Generous. Superficial with unrealistic values.

The whole system

In my specification I mentioned that "It must turn on when it goes dark for a specific time (2-3 hours) then automatically turn off so it should have an electronic switch a timing circuit and it must use red LED. The prototype must use low voltage and current which will be safe i.e. around 0-15 volts. The total current of the circuit should be with in 0.001 to 4mA and it stay on for the specified time. I am not going to wait 2-3 hours for the circuit to turn off so will set the time for only few seconds." My circuit which I have built now does turns on when it goes dark and then automatically turns off after the set time. I know I have been using a green LED but I have replaced it with a red one he photograph below shows this. My circuit uses a 5V power supply and the total current of the circuit is from 0.01-0.03 mili amps the pictures above in the measurements section prove this so over all I think that my circuit works well.

below shows this. The pictures above in the measurements section prove this so over all I think that my circuit works well.



→ $P = V \times I^2$

$P = 5 \times (4 \times 4)$

$P = 5 \times 16$

$80 = 5 \times 16$

The power consumption of my circuit is 80w

Oh dear!
Basic errors like this must be identified.

Limitations and modifications

I have modified my circuit to set the sensitivity of light. So if I wanted to make it turn on when it is just evening it will turn on. The limitation of my circuit is that if I set the sensitivity to high it will turn on even if it is under a shadow of few clouds. That is why in my specification at first I thought of using a worked out resistor value then I changed my plans and used a variable resistor which allows me to set the sensitivity of the light.

It can also be modified so it is possible to set the amount of time it stays on i.e. in winter people don't stay out side too long because of cold but in summer people do stay out side longer at night. To carry out this modification I could replace the resistor (R) the timing resistor in my second sub system with a variable resistor which will allow me to set the amount of time the LED stays on after the circuit has been triggered.

The picture below shows my modification of the circuit

Before **Afte**

Ce0
These are not limitations of the system performance but the design of the system. It is important that the system is well specified and tested.

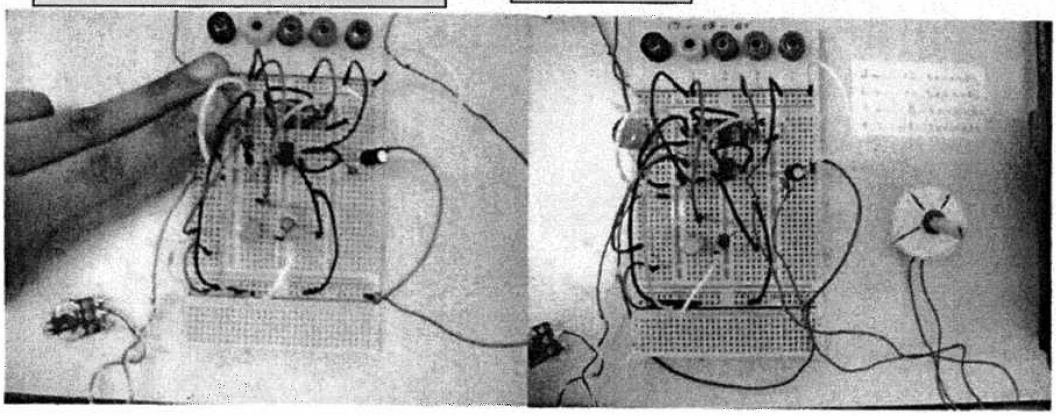
Candidate worked with Some Skill and Safety was always paramount to him

tutor.

Bf1
No evidence of a Risk Assessment, but two subsystems constructed and witness statement from tutor.

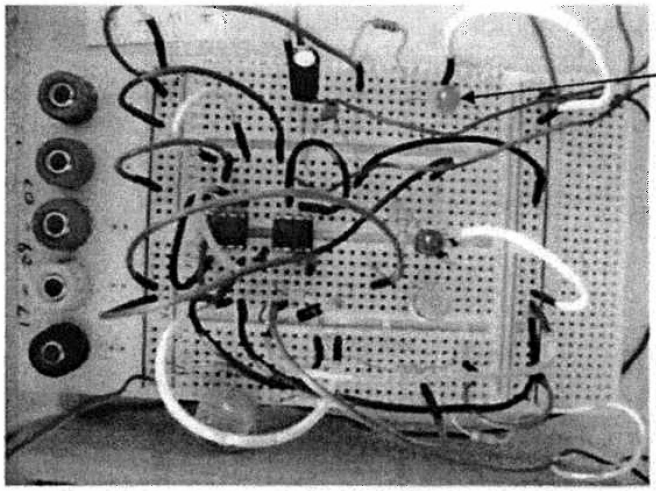
Bg1
Possibly generous. Wires too long but this is a problem with pre-terminated wires.

Bh2
System works.



I have replaced the resistor R with a calibrated variable resistor which allows me set the time for the circuit to stay on and turn off. My circuit above on the right gives the information of the times the circuit I have made it to stay on after triggered and allows user to choose from 4 settings of time. The times I have chosen for my circuit to stay on are 13 seconds, 11seconds, 8 seconds and 4 seconds originally my circuit stayed on for about 6 seconds as you can see I have successfully modified the circuit to stay on for different periods of times which is only set for few seconds like wise in reality I could set the circuit to stay on for longer period of time to meet the peoples need.

I found another limitation which was that my circuit is powered by high voltage when it is using a lamp or big LED which uses more current so to be able to make my circuit cope with that I will have to replace the transistor with a mosfet which is able to cope with a higher current and switches quickly. And when it is using a dc power supply like a battery i.e when it is only powering a small LED so the user can not know if the circuit is working as working or is the battery is useable or not so the circuit need an indication to show that there is power going into the circuit and the battery is useable so to over come this I have added a LED from $^{+}$V rail to ^{0}V rail which will turn on when the circuit is turned on indicating that the circuit is turned on and the battery is usable. This modification is shown below in the picture.



The LED to show that the circuit is turned on and the battery is usable.

This is also not a limitation of the system but the design.

Cf0
No re-assessment of the system after the modifications.

Da1
Report matches description for this mark.

Db1
Good photographs but no full circuit diagram.

Dc1
No summary of sources of information and help.